United States
Department of
Agriculture

Soil
Conservation
Service

In cooperation with
Kansas Agricultural
Experiment Station

Soil Survey of Saline County, Kansas

How To Use This Soil Survey

General Soil Map

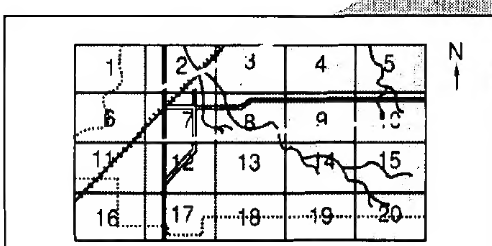
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

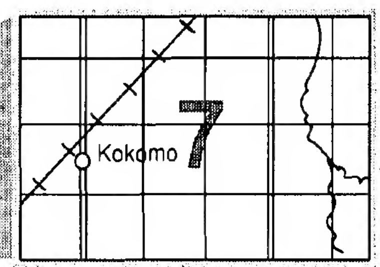
Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.

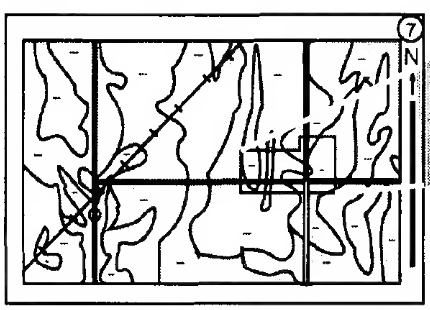


INDEX TO MAP SHEETS

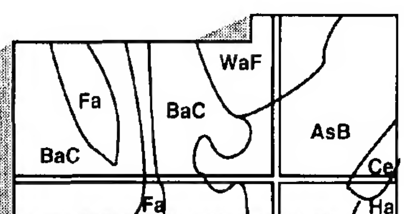


MAP SHEET

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



MAP SHEET



AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1988. Soil names and descriptions were approved in 1988. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1989. This survey was made cooperatively by the Soil Conservation Service and the Kansas Agricultural Experiment Station. It is part of the technical assistance furnished to the Saline County Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

All programs and services of the Soil Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: An area of Tobin and Wells soils. Lancaster and Hedville soils are in the background.

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Issued May 1992

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Foreword

This soil survey contains information that can be used in land-planning programs in Saline County, Kansas. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow over bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

James N. Habiger

James N. Habiger
State Conservationist
Soil Conservation Service

Soil Survey of Saline County, Kansas

By Cecil D. Palmer, Vernon L. Hamilton, Bruce R. Hoffman, Peter B. Fahnestock, and Wesley L. Barker, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service,
in cooperation with
Kansas Agricultural Experiment Station

SALINE COUNTY is in the north-central part of Kansas (fig. 1). It has an area of 461,645 acres, or about 720 square miles. In 1987, it had a population of 50,000. Most of the people live in Salina, the county seat. The county was organized in 1860.

Most of Saline County is in the Central Kansas Sandstone Hills major land resource area *(3)*. The eastern edge of the county, however, is in the Central Loess Plains land resource area. The soils in the county generally are deep or moderately deep, are nearly level to strongly sloping, and have a silty, clayey, or loamy subsoil. The highest elevation, more than 1,600 feet above sea level, is in an area in the western part of the county near Brookville. The lowest elevation, about 1,150 feet, is along the Smoky Hill River, in an area in the eastern part near Solomon.

Most of Saline County is drained by the Smoky Hill River and its tributaries, which flow north and east across the county. The northern part of the county is drained by the Saline and Solomon Rivers. Spring Creek, Mulberry Creek, and Gypsum Creek are other major tributaries in the county.

Many upland areas do not have an adequate supply of water for domestic and livestock uses. Rural water districts help to distribute water to these areas. The water supply generally is better in the valleys along the major streams. Some of the soils in these valleys are irrigated. The irrigation water is drawn from wells or local streams or is surface water impounded by dams.

Farming, ranching, and services related to these activities are some of the main enterprises in the county. About 38 percent of the county is rangeland, 49 percent is cropland, and 13 percent is small water areas, farmsteads, roads, and urban and other areas *(9)*. Wheat, alfalfa, soybeans, and grain sorghum are the principal crops.

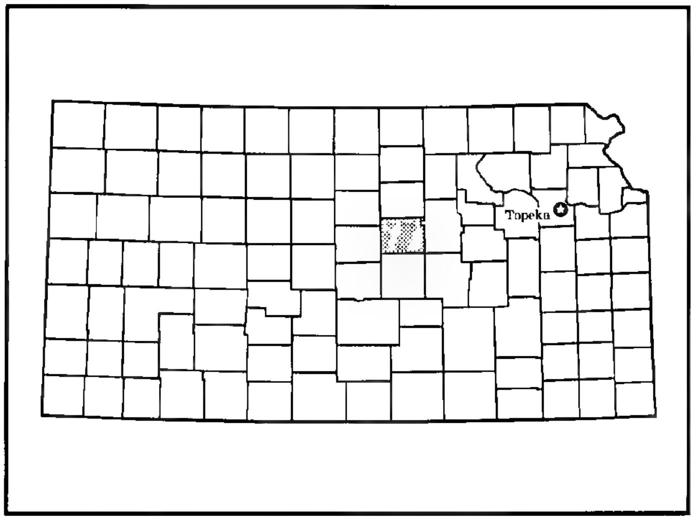

Figure 1.—Location of Saline County in Kansas.

This soil survey updates the survey of Saline County published in 1959 *(4)*. It provides additional information and has larger maps, which show the soils in greater detail.

Climate

Prepared by L. Dean Bark, climatologist, Kansas Agricultural Experiment Station, Manhattan, Kansas.

The climate of Saline County is typical continental, as can be expected of a location in the interior of a large landmass in the middle latitudes. It is characterized by

large daily and annual variations in temperature. Winters are cold because of frequent outbreaks of polar air. The cold temperatures prevail only from December to February. Warm summer temperatures prevail for about 6 months every year. They provide a long growing season for the crops grown in the county. Spring and fall are relatively short.

Saline County is generally along the western edge of the flow of moisture-laden air from the Gulf of Mexico. Shifts in this current result in a rather large range in the amount of precipitation. Precipitation is heaviest from May through September, when much of it falls during late-evening or nighttime thunderstorms. Precipitation in dry years is marginal for agricultural production. Even in wet years, crops commonly are adversely affected by prolonged periods without rain.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Salina in the period 1951 to 1980. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 30.9 degrees F and the average daily minimum temperature is 20.2 degrees. The lowest temperature on record, which occurred at Salina on February 13, 1905, is -31 degrees. In summer, the average temperature is 78.4 degrees and the average daily maximum temperature is 90.3 degrees. The highest recorded temperature, which occurred at Salina on August 13, 1936, is 118 degrees.

The total annual precipitation is 28.95 inches. Of this, 20.89 inches, or 72 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 15.78 inches or more than 25.25 inches. The heaviest 1-day rainfall during the period of record was 5.84 inches on May 21, 1971.

Severe windstorms and tornadoes accompany well developed thunderstorms, but they are infrequent and of local extent. Losses from hail are more severe, but they are not so great as those in counties to the west.

The average seasonal snowfall is 20.2 inches. The highest recorded seasonal snowfall is 52 inches, which occurred during the winter of 1959-60. On the average, 20 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The sun shines 76 percent of the time possible in summer and 64 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 13.0 miles per hour, in March and April. Average annual windspeed is 11.0 miles per hour.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, soil reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the

arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are named and mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The descriptions and names of the soils identified on the general soil map of this county do not fully agree with those of the soils identified on the maps of adjacent counties. Differences result from a better knowledge of soils, modifications in series concepts, a higher or lower intensity of mapping, and variations in the extent of the soils in the counties.

Soil Descriptions

1. Wells-Crete-Lancaster Association

Deep and moderately deep, nearly level to strongly sloping, well drained and moderately well drained soils that have a clayey or loamy subsoil; on uplands

This association is on narrow ridgetops and side slopes drained by intermittent streams. Slopes range from 0 to 12 percent.

This association makes up about 30 percent of the county. It is about 45 percent Wells soils, 25 percent Crete and similar soils, 10 percent Lancaster and similar soils, and 20 percent minor soils (fig. 2).

The deep, gently sloping and moderately sloping, well drained Wells soils formed in material weathered from sandstone, in colluvium, and in old alluvium. They are on ridgetops and side slopes. Typically, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is about 40 inches thick. The upper part is brown, friable loam; the next part is yellowish red and reddish yellow, firm clay loam; and the lower part is reddish yellow, friable clay loam. The substratum to a depth of about 60 inches is reddish yellow loam.

The deep, nearly level to moderately sloping, moderately well drained Crete soils formed in loess on ridgetops and side slopes. Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is grayish brown silt loam about 4 inches thick. The subsoil is about 40 inches thick. The upper part is grayish brown, firm silty clay loam; the next part is brown and pale brown, very firm silty clay; and the lower part is pale brown, firm, calcareous silty clay loam. The substratum to a depth of about 60 inches is light yellowish brown, calcareous silt loam.

The moderately deep, moderately sloping and strongly sloping, well drained Lancaster soils formed in material weathered from noncalcareous sandstone and sandy shale. They are on narrow ridgetops and side slopes. Typically, the surface layer is dark grayish brown loam about 9 inches thick. The subsoil is about 21 inches thick. The upper part is brown, friable clay loam; the next part is brown, firm clay loam; and the lower part is reddish yellow, firm sandy clay loam. Sandy shale bedrock is at a depth of about 30 inches.

Of minor extent in this association are the Edalgo, Geary, Hedville, Hord, and Tobin soils. The moderately deep, clayey Edalgo soils are on the upper side slopes and on narrow ridges. The shallow, somewhat excessively drained Hedville soils are on the more sloping, narrow ridgetops and sharp slope breaks. The deep, silty Hord soils are on stream terraces. The deep, silty Tobin soils are on narrow flood plains. The deep, silty Geary soils are on the lower side slopes.

This association is used mainly for cultivated crops, but about 30 percent of the acreage is used as range. Wheat, grain sorghum, and alfalfa are the main crops. Controlling erosion, conserving moisture, and maintaining good tilth and fertility are the main concerns in managing cropland.

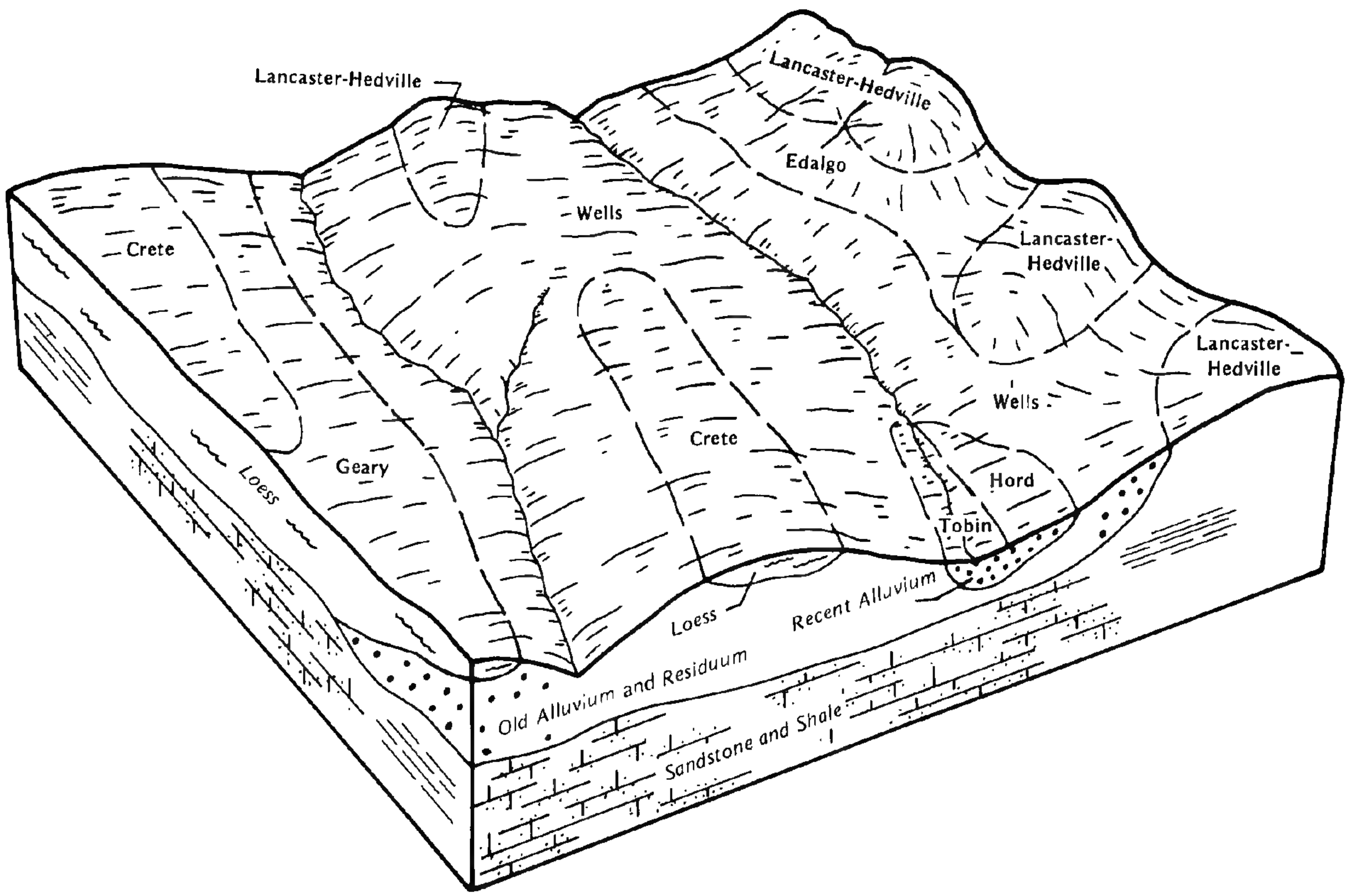

Figure 2.—Pattern of soils and parent material in the Wells-Crete-Lancaster association.

2. Lancaster-Hedville-Crete Association

Deep, moderately deep, and shallow, moderately sloping to moderately steep, well drained, somewhat excessively drained, and moderately well drained soils that have a loamy or clayey subsoil; on uplands

This association is on narrow ridgetops and side slopes. It is drained by many intermittent drainageways and a few small creeks. In some areas it is cut by deeply entrenched valleys. Shale and sandstone outcrops are common on the steeper slopes. Slopes range from 2 to 20 percent.

This association makes up about 30 percent of the county. It is about 40 percent Lancaster and similar soils, 17 percent Hedville soils, 16 percent Crete and similar soils, and 27 percent minor soils (fig. 3).

The moderately deep, moderately sloping and strongly sloping, well drained Lancaster soils formed in material weathered from noncalcareous sandstone and sandy shale. They are on narrow ridgetops and side slopes. Typically, the surface layer is dark grayish brown loam about 9 inches thick. The subsoil is about 21 inches thick. The upper part is brown, friable clay loam; the next part is brown, firm clay loam; and the lower part is reddish yellow, firm sandy clay loam. Sandy shale bedrock is at a depth of about 30 inches.

The shallow, moderately sloping to moderately steep, somewhat excessively drained Hedville soils formed in material weathered from noncalcareous sandstone on narrow ridgetops and sharp slope breaks. Typically, the surface layer is grayish brown loam about 8 inches thick. The subsoil is reddish brown, friable gravelly loam about 9 inches thick. Brown sandstone bedrock is at a depth of about 17 inches.

The deep, moderately sloping, moderately well drained Crete soils formed in loess on narrow ridgetops and side slopes. Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is grayish brown silt loam about 4 inches thick. The subsoil is about 40 inches thick. The upper part is grayish brown, firm silty clay loam; the next part is brown and pale brown, very firm silty clay;

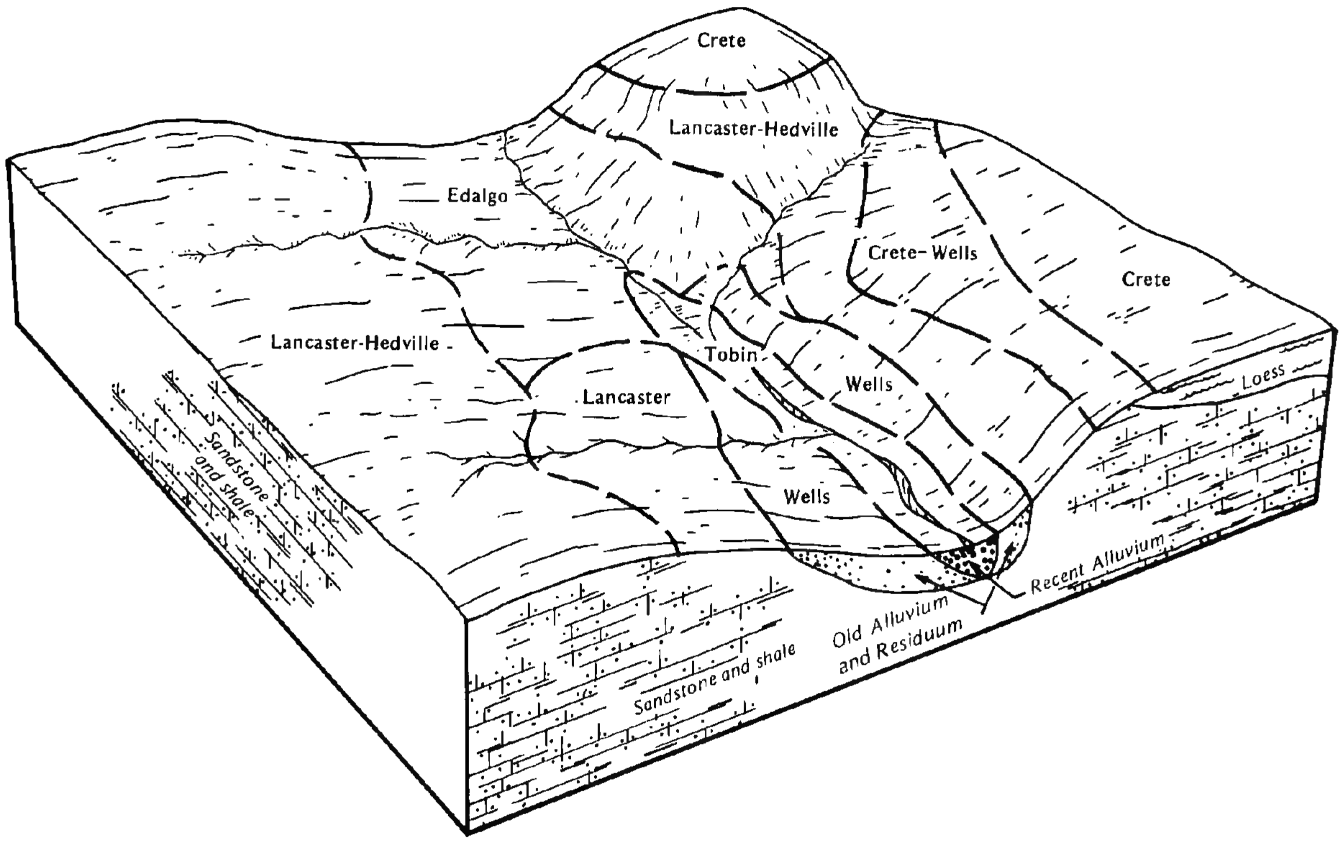

Figure 3.—Pattern of soils and parent material in the Lancaster-Hedville-Crete association.

and the lower part is pale brown, firm, calcareous silty clay loam. The substratum to a depth of about 60 inches is light yellowish brown, calcareous silt loam.

Of minor extent in this association are the Cass, Edalgo, Tobin, and Wells soils. The moderately rapidly permeable, loamy Cass soils are on flood plains along streams. The moderately deep, clayey Edalgo soils are on ridgetops and side slopes. The occasionally flooded Tobin soils are on flood plains along drainageways. The deep Wells soils are on side slopes.

This association is used mainly as range. Maintaining the growth and vigor of desirable grasses is the main concern in managing range.

3. Crete-Longford Association

Deep, nearly level to moderately sloping, moderately well drained and well drained soils that have a silty or clayey subsoil; on uplands

This association is on the tops and sides of ridges dissected by small drainageways. Slopes range from 0 to 7 percent.

This association makes up about 20 percent of the county. It is about 40 percent Crete and similar soils, 35 percent Longford soils, and 25 percent minor soils (fig. 4).

The nearly level to moderately sloping, moderately well drained Crete soils formed in loess on broad ridgetops and side slopes. Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is grayish brown silt loam about 4 inches thick. The subsoil is about 40 inches thick. The upper part is grayish brown, firm silty clay loam; the next part is brown and pale brown, very firm silty clay; and the lower part is pale brown, firm, calcareous silty clay loam. The substratum to a depth of about 60 inches is light yellowish brown, calcareous silt loam.

The gently sloping and moderately sloping, well drained Longford soils formed in loess on narrow ridgetops and side slopes. Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is about 34 inches thick. The upper part is brown, friable silty clay loam; the next part is reddish brown, firm silty clay; and the lower part is reddish yellow, friable silty clay loam. The substratum to

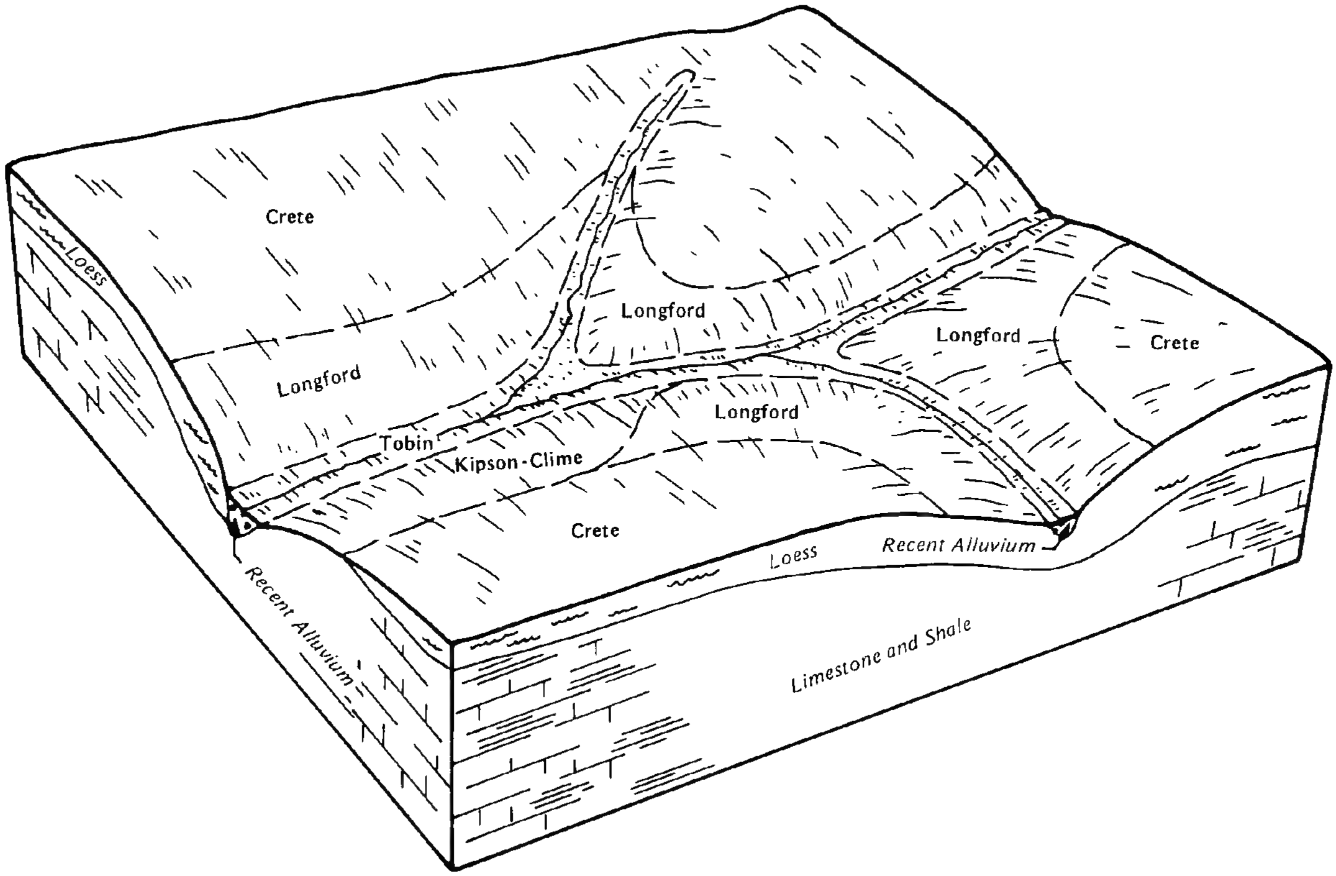

Figure 4.—Pattern of soils and parent material in the Crete-Longford association.

a depth of about 60 inches is light reddish brown, friable clay loam.

Of minor extent in this association are the Clime, Kipson, Tobin, and Wells soils. The moderately deep Clime soils and the deep Wells soils are on ridgetops and side slopes. The shallow Kipson soils are on side slopes in the uplands. The deep Tobin soils are on narrow flood plains along upland drainageways.

This association is used mainly for cultivated crops, but about 15 percent of the acreage is used as range. Wheat, grain sorghum, and alfalfa are the main crops. Controlling erosion, conserving moisture, and maintaining good tilth and fertility are the main concerns in managing cropland.

4. Detroit-Hord-Sutphen Association

Deep, nearly level, moderately well drained and well drained soils that have a silty or clayey subsoil; on stream terraces and flood plains

This association is on alluvial terraces in the valleys of the Saline, Smoky Hill, and Solomon Rivers. Slopes range from 0 to 2 percent.

This association makes up about 15 percent of the county. It is about 24 percent Detroit soils, 23 percent Hord soils, 18 percent Sutphen soils, and 35 percent minor soils.

The moderately well drained Detroit soils formed in silty alluvium on stream terraces that are subject to rare flooding. Typically, the surface layer is very dark grayish brown silty clay loam about 7 inches thick. The subsurface layer also is very dark grayish brown silty clay loam about 7 inches thick. The subsoil is about 32 inches thick. The upper part is very dark grayish brown and dark grayish brown, firm silty clay; the next part is brown, firm silty clay; and the lower part is brown, friable, calcareous silty clay loam. The substratum to a depth of about 60 inches is light yellowish brown, calcareous silt loam.

The well drained Hord soils formed in silty alluvium on stream terraces that are subject to rare flooding. Typically, the surface layer is dark grayish brown silt

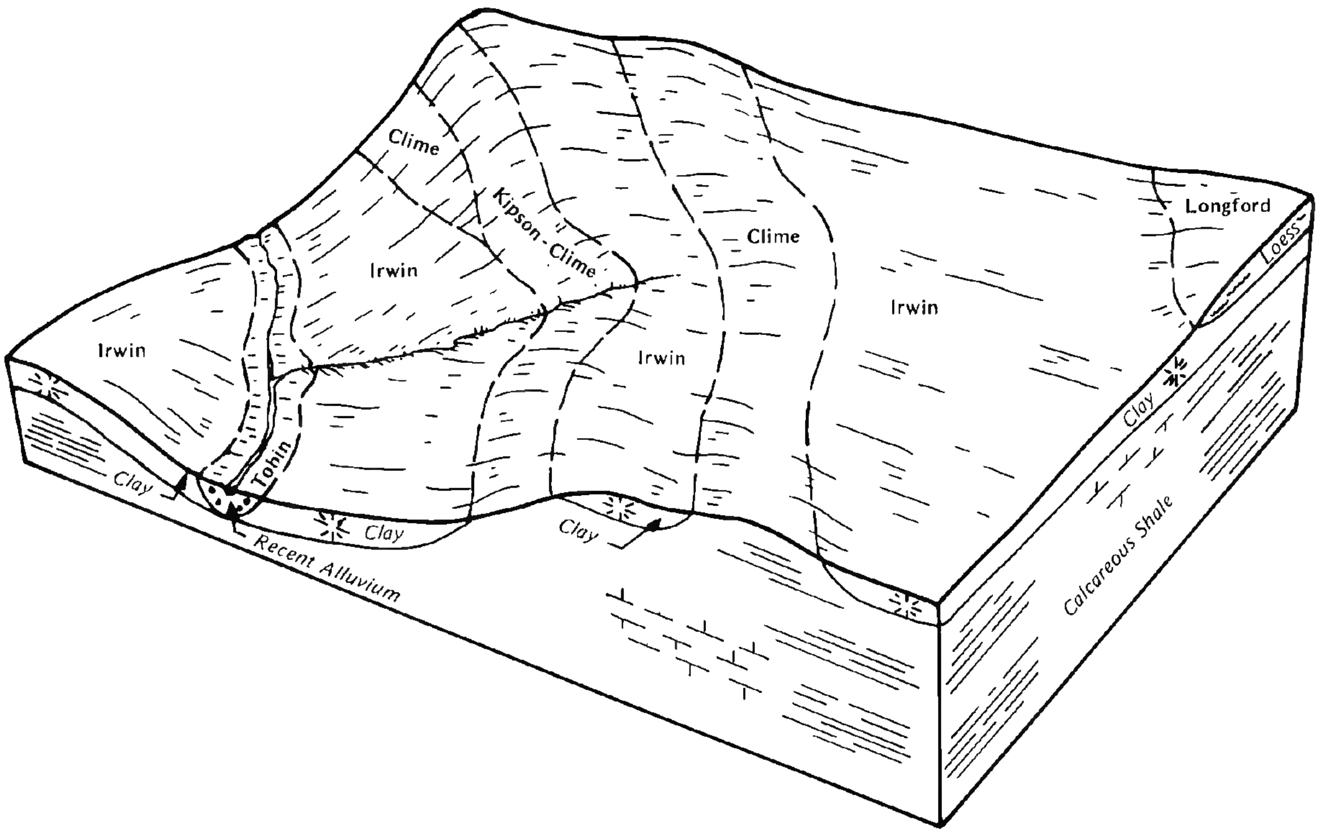

Figure 5.—Pattern of soils and parent material in the Irwin-Clime association.

loam about 7 inches thick. The subsurface layer also is dark grayish brown silt loam. It is about 8 inches thick. The subsoil is about 16 inches thick. The upper part is grayish brown, friable silty clay loam, and the lower part is brown, friable silt loam. The substratum to a depth of about 60 inches is pale brown, calcareous silt loam.

The moderately well drained Sutphen soils formed in clayey alluvium on flood plains that are occasionally flooded. Typically, the surface layer is very dark gray silty clay about 6 inches thick. The subsurface layer is very dark gray, very firm silty clay about 29 inches thick. The next layer is dark gray, very firm, calcareous silty clay about 12 inches thick. The substratum to a depth of about 60 inches is brown, calcareous silty clay that has concretions of lime.

Of minor extent in this association are the Cozad, McCook, New Cambria, Roxbury, Solomon, and Tobin soils. The well drained, rarely flooded Cozad, McCook, and Roxbury soils are on low terraces. The moderately well drained, rarely flooded New Cambria soils are on terraces. The well drained, occasionally flooded Tobin soils are on flood plains. The poorly drained, occasionally flooded Solomon soils are in depressions on low terraces.

Nearly all of this association is used for cultivated crops. Wheat, grain sorghum, and alfalfa are the main crops. The main concern in managing cropland is maintaining tilth and the organic matter content. Ponded water from upland drainageways is a management concern in some areas.

5. Irwin-Clime Association

Deep and moderately deep, gently sloping to moderately steep, moderately well drained and well drained soils that have a clayey subsoil; on uplands

This association is on broad ridgetops and side slopes dissected by intermittent streams. In places it is dissected by deeply entrenched drainageways. Slopes range from 1 to 20 percent.

This association makes up about 5 percent of the county. It is about 45 percent Irwin soils, 35 percent Clime soils, and 20 percent minor soils (fig. 5).

The deep, gently sloping and moderately sloping,

moderately well drained Irwin soils formed in clayey sediments on ridgetops and side slopes. Typically, the surface layer is dark grayish brown silty clay loam about 6 inches thick. The subsurface layer is dark grayish brown silty clay loam about 5 inches thick. The subsoil is about 32 inches thick. The upper part is dark grayish brown and brown, very firm clay, and the lower part is brown, very firm silty clay. The substratum to a depth of about 60 inches is brown, mottled, calcareous, very firm silty clay.

The moderately deep, moderately sloping to moderately steep, well drained Clime soils formed in material weathered from calcareous shale on side slopes. Typically, the surface layer is grayish brown, calcareous silty clay loam about 8 inches thick. The subsoil is yellowish brown, very firm, calcareous silty clay about 12 inches thick. The substratum is yellowish brown, calcareous silty clay about 8 inches thick. Shale bedrock is at a depth of about 28 inches.

Of minor extent in this association are the shallow, somewhat excessively drained Kipson and deep, well drained Longford soils on side slopes and the deep, well drained Tobin soils on flood plains.

This association is used mainly for cultivated crops, but some small areas are used as range. Wheat and grain sorghum are the main crops. Controlling water erosion and maintaining tilth and fertility are the main concerns in managing cropland. Maintaining the growth and vigor of desirable grasses and forbs is the main concern in managing range.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series.* Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases.* Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Geary silt loam, 1 to 3 percent slopes, is a phase of the Geary series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Lancaster-Hedville complex, 3 to 20 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

The descriptions and names of the soils identified on the detailed soil maps of this county do not fully agree with those of the soils identified on the maps of adjacent counties. Differences result from a better knowledge of soils, modifications in series concepts, a higher or lower intensity of mapping, and variations in the extent of the soils in the counties.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil Descriptions

Ba—Bavaria-Detroit complex. These deep, nearly level, moderately well drained soils are on stream terraces. They are subject to rare flooding. The Bavaria soil is in the slightly lower concave areas, and the Detroit soil is in the slightly higher convex areas. Slopes range from 0 to 2 percent. Individual areas are irregular in shape and range from 40 to 1,000 acres in size. They are about 60 percent Bavaria soil and 30 percent Detroit soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Bavaria soil has a surface layer of grayish brown silt loam about 6 inches thick. The subsurface layer is very dark gray silty clay loam about 7 inches thick. The subsoil is about 32 inches thick. The upper part is dark grayish brown and grayish brown, very firm, moderately saline silty clay. The lower part is brown, very firm, calcareous silty clay loam. The substratum to a depth of about 60 inches is pale brown, calcareous silty clay loam.

Typically, the Detroit soil has a surface layer of very dark grayish brown silt loam about 7 inches thick. The

subsurface layer is very dark grayish brown silty clay loam about 7 inches thick. The subsoil is about 32 inches thick. The upper part is very dark grayish brown and dark grayish brown, firm silty clay; the next part is brown, firm silty clay; and the lower part is brown, friable, calcareous silty clay loam. The substratum to a depth of about 60 inches is light yellowish brown, calcareous silt loam.

Included with these soils in mapping are small areas of the well drained Hord soils. These included soils contain less clay in the subsoil than the Bavaria and Detroit soils. They are in the higher, more convex areas. They make up about 10 percent of the map unit.

Permeability is slow in the Bavaria and Detroit soils. Surface runoff also is slow. Available water capacity is high in the Detroit soil and moderate in the Bavaria soil. Natural fertility is high in the Detroit soil and medium in the Bavaria soil. Organic matter content is low in the Bavaria soil and moderate in the Detroit soil. The sodium and soluble salts in the subsoil of the Bavaria soil retard the growth of most plants. This soil does not absorb moisture easily or release it readily to plants. Tilth is good in the Detroit soil and poor in the Bavaria soil. The surface of the Bavaria soil crusts when dry and puddles when wet. The shrink-swell potential is high in the subsoil of both soils.

Nearly all of the acreage is used for cultivated crops. These soils are moderately well suited to grain sorghum, forage sorghum, and alfalfa. Stands of wheat, which is less salt tolerant than other crops, are generally thin and spotty. Drought is a hazard in some years because the clayey subsoil does not readily release water to plants. Applying a system of conservation tillage and returning crop residue to the soil increase the rate of water infiltration and the organic matter content and improve fertility and tilth.

Because of the flooding and the high shrink-swell potential, these soils are generally unsuitable as sites for dwellings. Selecting the highest area on the landscape and constructing dikes, levees, or similar structures help to prevent the damage caused by floodwater. Properly designing and reinforcing foundations and installing sealed foundation drains help to prevent the structural damage caused by shrinking and swelling. Slab-on-grade foundations should not be used.

The Bavaria soil is only moderately well suited to sewage lagoons because of seepage. Sealing the lagoon helps to prevent seepage. Both soils are poorly suited to septic tank absorption fields because the slow permeability restricts the absorption of effluent. Enlarging the field helps to overcome the slow absorption rate.

The land capability classification is IIIs. The Detroit soil is in the Loamy Terrace range site, and the Bavaria soil is in the Saline Lowland range site.

Cd—Cass fine sandy loam, occasionally flooded. This deep, nearly level, well drained soil is on flood plains. It is occasionally flooded. Slopes range from 0 to 2 percent. Individual areas are long and narrow and range from 10 to 800 acres in size.

Typically, the surface layer is grayish brown fine sandy loam about 7 inches thick. The subsurface layer also is grayish brown fine sandy loam. It is about 6 inches thick. The next layer is brown, friable fine sandy loam about 11 inches thick. The substratum to a depth of about 60 inches is pale brown fine sandy loam. In places the dark surface soil is more than 20 inches thick.

Included with this soil in mapping are small areas of the silty Tobin soils. These soils are in the slightly lower landscape positions or in positions similar to those of the Cass soil. They make up about 5 percent of the map unit. Also included are frequently flooded soils in narrow, meandering stream channels. These soils make up 2 to 5 percent of the map unit.

Permeability is moderately rapid in the Cass soil, and surface runoff is slow. Available water capacity is moderate. Natural fertility is medium. The surface layer is neutral and very friable, and tilth is good.

Nearly all of the acreage is used for cultivated crops. This soil is well suited to wheat, grain sorghum, and alfalfa. Flooding and soil blowing are hazards. Flooding delays harvesting and planting and damages crops in some years, but in other years the extra moisture may increase crop yields. Overcoming the hazard of flooding is difficult without major flood-control measures. Cropping systems that include grasses or legumes and a system of conservation tillage that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration.

This soil is generally unsuited to building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures. The soil is unsuited to septic tank absorption fields because of the flooding and to sewage lagoons because of seepage and flooding.

The land capability classification is IIw, and the range site is Sandy Lowland.

Ce—Clime silty clay loam, 2 to 6 percent slopes. This moderately deep, moderately sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from 10 to 700 acres in size.

Figure 6.—Profile of Clime silty clay loam, 2 to 6 percent slopes. This soil is underlain by shale. Depth is marked in feet.

Typically, the surface layer is grayish brown silty clay loam about 8 inches thick. The subsoil is yellowish brown, very firm silty clay about 12 inches thick. The substratum is yellowish brown, very firm silty clay about 8 inches thick. Shale bedrock is at a depth of about 28 inches (fig. 6). The soil is calcareous throughout. In some areas soft limestone fragments are on the surface. In other areas the surface layer is light brownish gray. In places, the depth to bedrock is more than 40 inches and the surface layer is not calcareous.

Included with this soil in mapping are small areas of Irwin, Kipson, and Longford soils. The deep, moderately well drained Irwin soils are on the lower side slopes. The deep, well drained Longford soils are on ridgetops and the upper side slopes. The shallow Kipson soils are on narrow ridgetops and the upper side slopes. Included soils make up about 15 percent of the map unit.

Permeability is slow in the Clime soil, and surface runoff is medium. Available water capacity is low. Natural fertility is medium, and organic matter content is moderately low. The surface layer is firm and can be easily tilled only within a narrow range in moisture content. Root penetration is restricted by the shale bedrock at a depth of 20 to 40 inches. The shrink-swell potential is moderate in the subsoil.

Most of the acreage is used for cultivated crops. Some areas are used as range. This soil is poorly suited to wheat and sorghum. If cultivated crops are grown, water erosion is a hazard and droughtiness and poor tilth are limitations. Terraces, grassed waterways, contour farming, and a system of conservation tillage that leaves all or part of the crop residue on the surface reduce the runoff rate and help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration. The depth to bedrock should be considered when a terrace system is designed. In a few areas where terraces have been built, the root zone is severely restricted because most of the soil overlying the bedrock has been removed.

This soil is suited to range. Water erosion is a hazard in overgrazed areas. In some areas gullies form along cattle trails. Maintaining an adequate plant cover can help to control water erosion. Fencing and other means of controlling livestock traffic patterns can be used to prevent the formation of gullies and to give gullies time to revegetate. Range seeding is needed to restore the productivity of abandoned cropland.

The many areas where cropland is adjacent to range can be managed as habitat for upland wildlife, such as pheasants. Planting shrubs in these fringe areas provides winter cover for the wildlife.

This soil is only moderately well suited to dwellings because of the shrink-swell potential. Properly designing and reinforcing foundations and installing sealed foundation drains help to prevent the structural damage caused by shrinking and swelling. Slab-on-

grade foundations should not be used.

Because it is subject to seepage, is slowly permeable, and has a thin layer of suitable material, this soil is generally unsuited to septic tank absorption fields. It is poorly suited to sewage lagoons because of seepage. The deeper included soils are better sites for these uses.

The land capability classification is IVe, and the range site is Limy Upland.

Co—Cozad silt loam. This deep, nearly level, well drained soil is on terraces. It is subject to rare flooding. Slopes range from 0 to 2 percent. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer also is dark grayish brown silt loam. It is about 8 inches thick. The next layer is grayish brown silt loam about 6 inches thick. The upper part of the substratum is pale brown, very friable silt loam. The lower part to a depth of about 60 inches is pale brown, calcareous very fine sandy loam. In some places the depth to carbonates is more than 48 inches. In other places the surface soil and the upper part of the substratum contain more clay.

Included with this soil in mapping are a few small areas of Cass soils. These soils contain more sand than the Cozad soil. They are on small mounds. They make up about 5 percent of the map unit.

Permeability is moderate in the Cozad soil, and surface runoff is slow. Available water capacity is high. Natural fertility also is high. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content.

Nearly all of the acreage is used for cultivated crops. This soil is well suited to wheat, grain sorghum, forage sorghum, and alfalfa. Applying a system of conservation tillage that leaves all or part of the crop residue on the surface and adding other organic material improve fertility and tilth and increase the rate of water infiltration.

Areas along stream channels and edge areas where cropland is adjacent to range or woodland provide habitat for many kinds of wildlife, including deer, quail, rabbits, squirrels, and numerous songbirds. The habitat can be improved by planting trees or shrubs or by leaving small areas of unharvested crops along the edges of the cropland.

This soil is poorly suited to dwellings and moderately well suited to septic tank absorption fields. The flooding is a hazard affecting both uses. Dikes, levees, and other structures can reduce the hazard of flooding. Onsite inspection and knowledge of the flooding history of the area are needed when building sites are selected. The soil is only moderately well suited to sewage lagoons because of seepage. Sealing the lagoon helps to control seepage.

The land capability classification is I, and the range site is Loamy Terrace.

Cr—Crete silt loam, 0 to 2 percent slopes. This deep, nearly level, moderately well drained soil is on broad flats in the uplands. Individual areas are irregular in shape and range from 10 to 2,000 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is grayish brown silt loam about 4 inches thick. The subsoil is about 40 inches thick. It is grayish brown, firm silty clay loam in the upper part; brown and pale brown very firm silty clay in the next part; and pale brown, firm, calcareous silty clay loam in the lower part. The substratum to a depth of about 60 inches is light yellowish brown, calcareous silt loam. In some places, the subsurface layer is silty clay or silty clay loam and the upper part of the subsoil is clay. In other places the subsoil is pale brown. In some small areas in depressions, the soil is subject to ponding.

Permeability is slow in the subsoil and moderate or moderately slow in the substratum. Surface runoff is slow. Available water capacity is high. Natural fertility also is high. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is high in the subsoil.

Nearly all of the acreage is used for cultivated crops. This soil is well suited to wheat, grain sorghum, forage sorghum, and alfalfa. The clayey subsoil, however, restricts the movement of water and air and root development and slowly releases water to plants. Applying a system of conservation tillage that leaves all or part of the crop residue on the surface and adding other organic material improve fertility and tilth and increase the rate of water infiltration.

This soil is poorly suited to dwellings and septic tank absorption fields. It is moderately well suited to sewage lagoons. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations and installing sealed foundation drains help to prevent the structural damage caused by shrinking and swelling. Slab-on-grade foundations should not be used. The slow permeability restricts the absorption of effluent in septic tank absorption fields. It can be overcome by enlarging the field or by installing the lateral lines below the subsoil. Seepage is a limitation on sites for sewage lagoons. It can be controlled by sealing the lagoon.

The land capability classification is IIs, and the range site is Clay Upland.

Cs—Crete silt loam, 2 to 5 percent slopes. This deep, moderately sloping, moderately well drained soil is on convex side slopes in the uplands. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is grayish brown silt loam about 4 inches thick. The subsoil is about 40 inches thick. The upper part is grayish brown, firm silty clay loam; the next part is brown and pale brown, very firm silty clay; and the lower part is pale brown, firm, calcareous silty clay loam. The substratum to a depth of about 60 inches is light yellowish brown, calcareous silt loam. In places the lower part of the subsoil and the substratum are reddish yellow and reddish brown.

Included with this soil in mapping are small areas of the well drained Geary, Lancaster, Tobin, and Wells soils. These soils are less clayey than the Crete soil. Geary and Wells soils and the moderately deep Lancaster soils are on the lower side slopes. Tobin soils are along narrow drainageways and are occasionally flooded. Included soils make up about 20 percent of the map unit.

Permeability is slow in the subsoil of the Crete soil and moderate or moderately slow in the substratum. Surface runoff is medium. Available water capacity is high. Natural fertility also is high. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is high in the subsoil.

Nearly all areas are used for cultivated crops (fig. 7). This soil is moderately well suited to wheat, sorghum, and alfalfa. The clayey subsoil absorbs and releases moisture slowly. Water erosion is a hazard if cultivated crops are grown. Terracing, farming on the contour, applying a system of conservation tillage, and leaving crop residue on the surface help to control erosion, conserve moisture, and improve tilth.

The shrink-swell potential is a severe limitation if this soil is used as a site for dwellings. Properly designing and reinforcing foundations and installing sealed foundation drains help to prevent the structural damage caused by shrinking and swelling. Slab-on-grade foundations should not be used.

Slope and seepage are limitations on sites for sewage lagoons. Some land shaping commonly is needed to overcome the slope. Seepage can be controlled by sealing the lagoon. The slow permeability restricts the absorption of effluent in septic tank absorption fields. Increasing the size of the field or installing the lateral lines below the subsoil improves the functioning of the septic tank system.

The land capability classification is IIIe, and the range site is Clay Upland.

Cx—Crete-Wells complex, 2 to 7 percent slopes. These deep, moderately sloping soils are on ridgetops and side slopes in the uplands. The moderately well drained Crete soil is on side slopes and narrow ridgetops. The well drained Wells soil is on the more sloping, lower side slopes. Individual areas are irregular in shape and range from 20 to a few hundred acres in size. They are about 45 percent Crete silt loam and 40 percent Wells loam. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Crete soil has a surface layer of dark grayish brown silt loam about 6 inches thick. The subsurface layer is grayish brown, friable silt loam about 4 inches thick. The subsoil is about 40 inches thick. The upper part is grayish brown, firm silty clay loam; the next part is brown and pale brown, very firm silty clay; and the lower part is pale brown, firm, calcareous silty clay loam. The substratum to a depth of about 60 inches is light yellowish brown, calcareous silt loam.

Typically, the Wells soil has a surface layer of dark grayish brown loam about 8 inches thick. The subsoil is about 40 inches thick. The upper part is brown loam, the next part is yellowish red clay loam, and the lower part is reddish yellow clay loam. The substratum to a depth of about 60 inches is reddish yellow loam.

Included with these soils in mapping are small areas of Edalgo, Hedville, Lancaster, and Longford soils. The shallow Hedville soils are on narrow ridgetops. The moderately deep, loamy Lancaster soils and the moderately deep, clayey Edalgo soils are on side slopes. The deep Longford soils are on side slopes and ridgetops. Included soils make up about 15 percent of the map unit.

Permeability is slow in the subsoil of the Crete soil and moderate or moderately slow in the substratum. It is moderate in the Wells soil. Surface runoff is medium on both soils. Available water capacity is high. Natural fertility also is high. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is high in the subsoil of the Crete soil and moderate in the subsoil of the Wells soil.

About half of the acreage is used for cultivated crops, and the rest is used as range. These soils are moderately well suited to wheat, grain sorghum, and forage sorghum. Water erosion is a hazard if cultivated crops are grown. Terraces, grassed waterways, contour farming, and a system of conservation tillage that leaves all or part of the crop residue on the surface help

Figure 7.—Harvesting winter wheat in an area of Crete silt loam, 2 to 5 percent slopes.

to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve fertility and tilth and increase the rate of water infiltration.

These soils are suited to range. Water erosion is a hazard if the range is overgrazed. In some areas gullies form along cattle trails. An adequate plant cover helps to prevent excessive soil loss. Fencing and other means of controlling livestock traffic patterns can be used to prevent the formation of gullies and give gullies time to revegetate. A scheduled deferment of grazing during the growing season and a uniform distribution of grazing help to keep the range productive. Range seeding is needed to restore the productivity of abandoned cropland.

Edge areas where cropland is adjacent to range can be managed as habitat for upland wildlife, such as pheasants and quail. The habitat can be improved by planting trees or shrubs or by leaving small areas of unharvested crops along the edges of the cropland.

The Crete soil is poorly suited to dwellings, and the Wells soil is moderately well suited. The shrink-swell potential in the subsoil of both soils is a limitation. Properly designing and reinforcing foundations and installing sealed foundation drains help to prevent the structural damage caused by shrinking and swelling.

Slab-on-grade foundations should not be used.

The Wells soil is well suited to septic tank absorption fields, but the Crete soil is poorly suited. The slow permeability in the Crete soil restricts the absorption of effluent. It can be overcome by enlarging the field or by installing the lateral lines below the subsoil.

These soils are moderately well suited to sewage lagoons. Seepage and slope are limitations. Seepage can be controlled by sealing the lagoon. If the less sloping areas are selected as sites for lagoons, less leveling and banking will be needed during construction.

The land capability classification is IIIe. The Crete soil is in the Clay Upland range site, and the Wells soil is in the Loamy Upland range site.

De—Detroit silty clay loam. This deep, nearly level, moderately well drained soil is on stream terraces. It is subject to rare flooding. Slopes range from 0 to 2 percent. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is very dark grayish brown silty clay loam about 7 inches thick. The subsurface layer also is very dark grayish brown silty clay loam about 7 inches thick. The subsoil is about 32 inches thick. The upper part is very dark grayish brown, dark grayish brown, and brown, firm silty clay, and the lower part is brown, friable, calcareous silty clay loam. The upper part of the substratum is light yellowish brown, calcareous silt loam. The lower part to a depth of about 60 inches is light brownish gray, calcareous silty clay loam. In places the surface layer is calcareous silty clay.

Included with this soil in mapping are small areas of Hord and Sutphen soils. The well drained Hord soils are along streams in the higher convex areas. They contain less clay in the subsoil than the Detroit soil. Sutphen soils contain more clay than the Detroit soil. They are in the lower, more concave depressions. Also included are small areas of the moderately saline Bavaria soils in depressions. Included soils make up about 10 percent of the map unit.

Permeability is slow in the Detroit soil. Surface runoff also is slow. Available water capacity is high. Organic matter content is moderate, and natural fertility is high. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is high in the subsoil.

Nearly all of the acreage is used for cultivated crops. This soil is well suited to wheat, grain sorghum, forage sorghum, and alfalfa. Drought is a hazard in some years because the clayey subsoil does not readily release water to plants. A system of conservation tillage that leaves all or part of the crop residue on the surface increases the rate of water infiltration and helps to maintain the organic matter content, fertility, and good tilth.

This soil is poorly suited to dwellings. The flooding is the main hazard. Also, the shrink-swell potential is a severe limitation. Selecting the highest area on the landscape and constructing dikes, levees, or similar structures help to prevent the damage caused by floodwater. Properly designing and reinforcing foundations and installing sealed foundation drains help to prevent the structural damage caused by shrinking and swelling. Slab-on-grade foundations should not be used.

This soil is well suited to sewage lagoons. It is poorly suited to septic tank absorption fields, however, because the slow permeability restricts the absorption of effluent. Enlarging the field helps to overcome the slow absorption rate.

The land capability classification is I, and the range site is Loamy Terrace.

Ed—Edalgo clay loam, 3 to 7 percent slopes. This moderately deep, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from 5 to 400 acres in size.

Typically, the surface layer is dark grayish brown clay loam about 9 inches thick. The subsoil is about 12 inches thick. The upper part is brown, very firm clay loam, and the lower part is light brown, very firm silty clay. The substratum is brownish yellow and light gray, very firm silty clay about 7 inches thick. Clayey shale bedrock is at a depth of about 28 inches. In places the depth to clayey shale is more than 40 inches or is 4 to 20 inches. In areas where the upper part of the subsoil has been mixed with the surface layer by tillage, the surface layer is brown clay loam or silty clay loam.

Included with this soil in mapping are small areas of Crete, Lancaster, and Wells soils and small areas of soils affected by sodium. The deep, moderately well drained Crete soils are on ridgetops and the upper side slopes. Lancaster soils contain less clay in the subsoil than the Edalgo soil. They are in positions on the landscape similar to those of the Edalgo soil. The deep Wells soils are on the upper side slopes. The soils affected by sodium are on narrow ridges. Included soils make up about 20 percent of the map unit.

Permeability is very slow in the Edalgo soil, and surface runoff is rapid. Available water capacity is low. Natural fertility is medium. The surface layer is friable, but it can be easily tilled only within a narrow range in moisture content. Root penetration is restricted below a depth of 20 to 40 inches. The shrink-swell potential is high in the subsoil.

About half of the acreage is used for cultivated crops, is abandoned cropland, or has been reseeded to grass.

The other half is used as range. This soil is poorly suited to wheat and grain sorghum. Water erosion is a hazard if cultivated crops are grown. Terraces, grassed waterways, contour farming, and a system of conservation tillage that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve fertility and tilth and increase the rate of water infiltration. The depth to bedrock should be considered when a terrace system is designed. In a few areas where terraces have been built, the root zone is severely restricted because most of the soil overlying the bedrock has been removed.

This soil is better suited to range than to cultivated crops. Water erosion is a hazard if the range is overgrazed. Fencing and other means of controlling livestock traffic patterns can be used to prevent the formation of gullies and to give gullies time to revegetate. An adequate plant cover helps to prevent excessive soil loss. Seeding is needed to improve the productivity of abandoned cropland and of other areas that do not have an adequate natural seed source. Proper stocking rates, a uniform distribution of grazing, a scheduled deferment of grazing during the growing season, and timely burning help to keep the range productive.

This soil is poorly suited to dwellings, septic tank absorption fields, and sewage lagoons because of the very slow permeability, the high shrink-swell potential, and the depth to bedrock. The deeper soils on the lower side slopes are better sites for these uses.

The land capability classification is IVe, and the range site is Clay Upland.

Ge—Geary silt loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on ridgetops and side slopes in the uplands. Individual areas are irregular in shape and range from 20 to 200 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. The subsoil is brown silty clay loam about 33 inches thick. The upper part is firm, and the lower part is friable. The substratum to a depth of about 60 inches is reddish brown, calcareous silty clay loam. In places the surface layer is loam or fine sandy loam. In areas where the upper part of the subsoil has been mixed with the surface soil by tillage, the surface layer is silty clay loam.

Included with this soil in mapping are small areas of Clime and Crete soils. The calcareous, moderately deep, clayey Clime soils are on the lower side slopes. Crete soils contain more clay in the subsoil than the Geary soil. They are on the higher ridgetops and side slopes. Included soils make up about 10 percent of the map unit.

Permeability is moderate in the Geary soil, and surface runoff is medium. Available water capacity is high. Natural fertility also is high. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate in the subsoil.

Nearly all of the acreage is used for cultivated crops. This soil is well suited to wheat, grain sorghum, and alfalfa. Water erosion is a hazard if cultivated crops are grown. Terraces, grassed waterways, contour farming, and a system of conservation tillage that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration.

This soil is moderately well suited to dwellings, septic tank absorption fields, and sewage lagoons. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations and installing sealed foundation drains help to prevent the structural damage caused by shrinking and swelling. Slab-on-grade foundations should not be used. The moderate permeability restricts the absorption of effluent in septic tank absorption fields. It can be overcome by enlarging the field. Seepage and slope are limitations on sites for sewage lagoons. Seepage can be controlled by sealing the lagoon. If the less sloping areas are selected as sites for lagoons, less leveling and banking will be needed during construction.

The land capability classification is IIe, and the range site is Loamy Upland.

Gf—Geary silt loam, 3 to 7 percent slopes. This deep, moderately sloping, well drained soil is on side slopes and along drainageways in the uplands. Individual areas are irregular in shape and range from 10 to 800 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. The subsoil is brown silty clay loam about 33 inches thick. The upper part is firm, and the lower part is friable. The substratum to a depth of about 60 inches is reddish brown, calcareous silty clay loam. In places the surface layer is loam or fine sandy loam. In areas where the upper part of the subsoil has been mixed with the surface soil by tillage, the surface layer is silty clay loam.

Included with this soil in mapping are small areas of Clime, Crete, and Tobin soils. The calcareous, moderately deep, clayey Clime soils are on the lower side slopes. Crete soils contain more clay in the subsoil than the Geary soil. They are on the upper side slopes.

Figure 8.—Contour farming and terraces in an area of Geary silt loam, 3 to 7 percent slopes.

The occasionally flooded Tobin soils are on narrow flood plains. Included soils make up about 15 percent of the map unit.

Permeability is moderate in the Geary soil, and surface runoff is medium. Available water capacity is high. Natural fertility also is high. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate in the subsoil.

Nearly all of the acreage is used for cultivated crops. This soil is moderately well suited to wheat, grain sorghum, and alfalfa. Water erosion is a hazard if cultivated crops are grown. Terraces, grassed waterways, contour farming (fig. 8), and a system of conservation tillage that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration.

This soil is moderately well suited to dwellings, septic tank absorption fields, and sewage lagoons. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations and installing sealed foundation drains help to prevent the structural damage caused by shrinking and swelling. Slab-on-grade foundations should not be used. The moderate permeability restricts the absorption of effluent in septic tank absorption fields. It can be overcome by enlarging the field. Seepage and slope are limitations on sites for sewage lagoons. Seepage can be controlled by sealing the lagoon. If the less sloping areas are selected as sites for lagoons, less leveling and banking will be needed during construction.

The land capability classification is IIIe, and the range site is Loamy Upland.

Ho—Hord silt loam. This deep, nearly level, well drained soil is on stream terraces. It is subject to rare flooding. Slopes range from 0 to 2 percent. Individual areas are irregular in shape and range from 10 to 1,200 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 8 inches thick

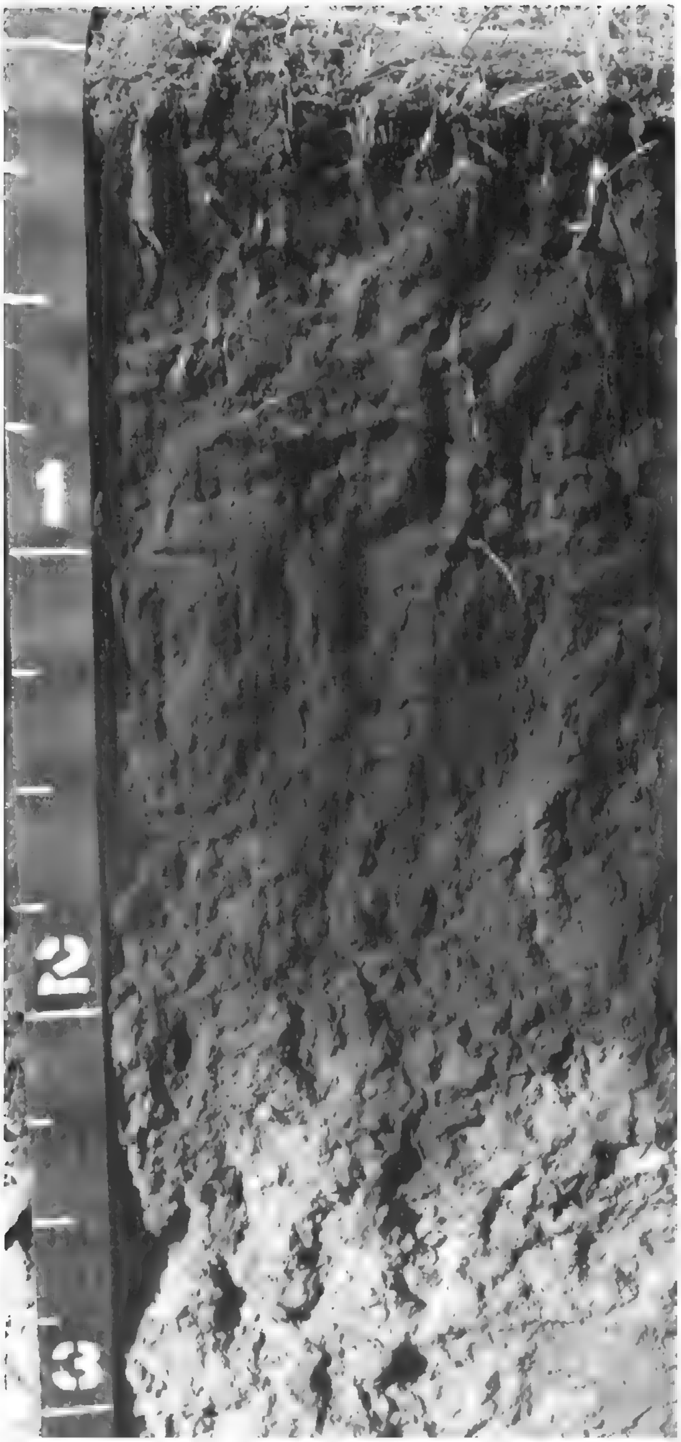

Figure 9.—Profile of Hord silt loam. This soil is dark to a depth of 20 to 40 inches. Depth is marked in feet.

(fig. 9). The subsoil is about 16 inches thick. It is friable. The upper part is grayish brown silty clay loam, and the lower part is brown silt loam. The substratum to a depth of about 60 inches is pale brown, calcareous silt loam. In some places the soil is calcareous near the surface. In other places the soil is leached to a greater depth and the substratum has no calcium carbonate.

Included with this soil in mapping are small areas of Detroit and New Cambria soils. These moderately well drained soils are in slight depressions. They are more clayey than the Hord soil. They make up about 10 percent of the map unit.

Permeability is moderate in the Hord soil, and surface runoff is slow. Available water capacity is high. Organic matter content is moderate, and natural fertility is high. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content.

Most of the acreage is used for cultivated crops (fig. 10). This soil is well suited to wheat, grain sorghum, forage sorghum, and alfalfa. A system of conservation tillage that leaves all or part of the crop residue on the surface increases the rate of water infiltration and helps to maintain the organic matter content and good tilth.

This soil is poorly suited to dwellings because of the flooding. Selecting the highest area on the landscape and constructing dikes or levees help to prevent the damage caused by floodwater. Onsite inspection and knowledge of the flooding history of the area are needed when building sites are selected.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. Flooding is a hazard on sites for septic tank systems, and seepage is a limitation on sites for sewage lagoons. Dikes and levees help to prevent flood damage. Sealing sewage lagoons helps to control seepage.

The land capability classification is I, and the range site is Loamy Terrace.

Ir—Irwin silty clay loam, 1 to 3 percent slopes. This deep, gently sloping, moderately well drained soil is on convex ridgetops and side slopes in the uplands. Individual areas are irregular in shape and range from 5 to more than 500 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 6 inches thick. The subsurface layer also is dark grayish brown silty clay loam. It is about 5 inches thick. The subsoil is about 32 inches thick. The upper part is dark grayish brown and brown, very firm clay. The lower part is brown, very firm, calcareous silty clay. The substratum to a depth of about 60 inches is brown, mottled, very firm silty clay. In some places, the subsoil is browner and the substratum is brown silty clay loam. In other places clayey shale bedrock is within a depth of 60 inches. In a few areas, all or part of the original surface layer has been lost through erosion and the present surface layer is more clayey.

Included with this soil in mapping are small areas of the moderately deep, calcareous Clime soils along

Figure 10.—Alfalfa and corn in an area of Hord silt loam.

small, intermittent drainageways and on low mounds. These soils make up about 5 percent of the map unit.

Permeability is very slow in the Irwin soil, and surface runoff is medium. Available water capacity is moderate. Natural fertility is medium. The surface layer is friable, but it can be easily tilled only within a narrow range in moisture content. In eroded areas the surface layer crusts after hard rains. The shrink-swell potential is high.

Most of the acreage is used as cropland. This soil is moderately well suited to wheat, grain sorghum, and alfalfa. If cultivated crops are grown, erosion and drought are hazards. Conservation tillage, grassed waterways, terraces, and contour farming help to prevent excessive soil loss. Returning crop residue to the soil improves fertility, increases the content of organic matter, minimizes crusting, and increases the rate of water infiltration.

This soil is severely limited as a site for dwellings because of the shrink-swell potential. Properly designing and reinforcing foundations and installing sealed foundation drains help to prevent the structural damage caused by shrinking and swelling. Slab-on-grade foundations should not be used. The soil is severely limited as a site for septic tank absorption fields because of the very slow permeability. This limitation can be overcome by enlarging the field. In some areas the slope is a moderate limitation on sites for sewage lagoons.

The land capability classification is IIIe, and the range site is Clay Upland.

Is—Irwin silty clay loam, 3 to 7 percent slopes. This deep, moderately well drained, moderately sloping soil is on convex slopes paralleling intermittent drainageways in the uplands. Individual areas are irregular in shape and range from 5 to more than 600 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 6 inches thick. The subsurface layer also is dark grayish brown silty clay loam. It is about 5 inches thick. The subsoil is about 32 inches thick. The upper part is dark grayish brown and brown, very firm clay. The lower part is brown, very firm, calcareous silty clay. The substratum to a depth of about 60 inches is brown, very firm silty clay. In places, the subsoil is browner and the substratum is brown silty clay loam. In a few areas, most of the original surface layer has been lost through erosion and the present surface layer is grayish brown and is more clayey. In some areas clayey shale bedrock is within a depth of 60 inches.

Included with this soil in mapping are small areas of the moderately deep, calcareous Clime soils. These soils are on the upper parts of side slopes. They make up about 10 percent of the map unit.

Permeability is very slow in the Irwin soil, and surface runoff is rapid. Available water capacity is moderate. Natural fertility is medium. The surface layer is friable, but it can be easily tilled only within a narrow range in moisture content. In eroded areas the surface crusts after hard rains. The shrink-swell potential is high.

Nearly all areas are used as cropland. This soil is poorly suited to wheat, grain sorghum, and alfalfa. If cultivated crops are grown, erosion and drought are hazards. Conservation tillage, grassed waterways, terraces, and contour farming help to prevent excessive soil loss. Returning crop residue to the soil improves fertility, minimizes crusting, and increases the rate of water infiltration.

This soil is severely limited as a site for dwellings because of the shrink-swell potential. Properly designing and reinforcing foundations and installing sealed foundation drains help to prevent the structural damage caused by shrinking and swelling. Slab-on-grade foundations should not be used. The soil is severely limited as a site for septic tank absorption fields because of the very slow permeability. This limitation can be overcome by enlarging the field. The slope is a moderate limitation on sites for sewage lagoons. The less sloping nearby areas are better sites for lagoons.

The land capability classification is IVe, and the range site is Clay Upland.

Kc—Kipson-Clime complex, 6 to 20 percent slopes. These somewhat excessively drained and well drained, moderately deep and shallow soils are on uplands. Individual areas are irregular in shape and range from 10 to more than 900 acres in size. They are about 45 percent Kipson soil and 40 percent Clime soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Kipson soil has a surface layer of gray silt loam about 7 inches thick. The subsoil is light brownish gray, friable silty clay loam about 6 inches thick. The substratum is light gray silty clay loam about 5 inches thick. Shale and chalky limestone bedrock is at a depth of about 18 inches (fig. 11).

Typically, the Clime soil has a surface layer of grayish brown, calcareous silty clay loam about 8 inches thick. The subsoil is yellowish brown, very firm, calcareous silty clay about 12 inches thick. The substratum also is yellowish brown, very firm, calcareous silty clay. It is about 8 inches thick. Weathered shale bedrock is at a depth of about 28 inches. In some areas soft limestone fragments are on the surface.

Included with these soils in mapping are small areas of Tobin soils and rock outcrops. The well drained Tobin soils are on narrow flood plains that dissect the uplands. The rock outcrops occur as chalky limestone in areas below the Kipson soil. Included areas make up about 15 percent of the map unit.

Permeability is slow in the Clime soil and moderate in the Kipson soil. Surface runoff is rapid on both soils. Available water capacity is low in the Clime soil and very low in the Kipson soil. Natural fertility is medium in both soils. Root penetration is restricted by the clayey shale at a depth of 20 to 40 inches in the Clime soil and by the clayey shale and chalky limestone at a depth of 7 to 20 inches in the Kipson soil. The shrink-swell potential is moderate in the subsoil of both soils.

These soils are best suited to range. The major management concerns are the hazard of erosion and droughtiness. An adequate plant cover and ground mulch help to prevent excessive soil loss and improve the moisture-supplying capacity by reducing the runoff rate. Overgrazing depletes the protective plant cover and causes deterioration of the plant community. Under these conditions, the more desirable grasses are replaced by less productive mid and short grasses and by weeds. Proper stocking rates, a uniform distribution of grazing, and timely deferment of grazing help to keep the range in good condition. Brush management improves the range in excessively grazed areas where brush and trees have invaded. Good sites for stock water ponds are available in many areas.

These soils are moderately limited as sites for dwellings because of the shrink-swell potential and the slope. Properly designing and reinforcing foundations and installing sealed foundation drains help to prevent structural damage caused by shrinking and swelling. Slab-on-grade foundations should not be used.

Because of the slow permeability, the depth to bedrock, and seepage, the Clime soil is severely limited

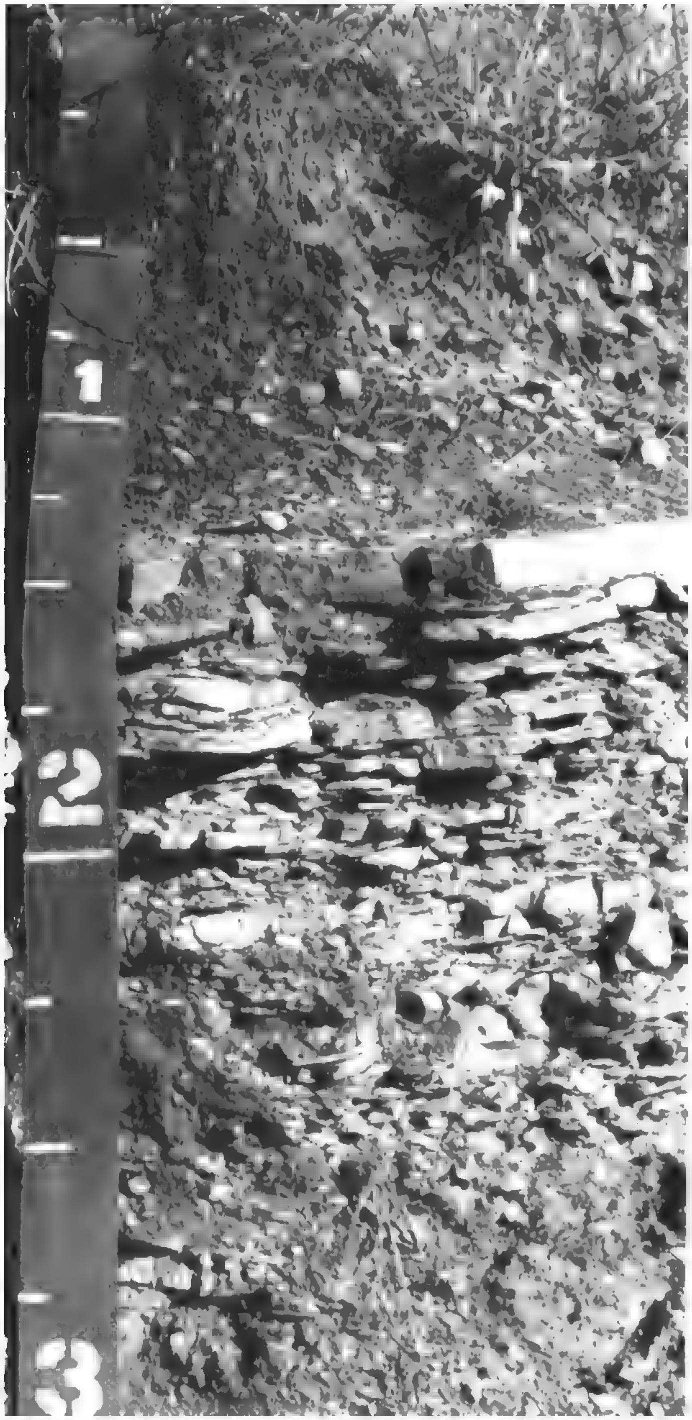

Figure 11.—Profile of Kipson silt loam. Shale and chalky limestone bedrock is at a depth of about 1.5 feet.

as a site for septic tank absorption fields. It is severely limited as a site for sewage lagoons because of seepage and slope. The Kipson soil is generally unsuitable as a site for septic tank absorption fields and sewage lagoons because of the depth to bedrock, the slope, and seepage.

The land capability classification is VIe, and the range site is Limy Upland.

Lf—Lancaster loam, 3 to 7 percent slopes. This moderately deep, moderately sloping, well drained soil is on ridgetops and the upper side slopes. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is dark grayish brown loam about 9 inches thick. The subsoil is about 21 inches thick. The upper part is brown, friable clay loam; the next part is brown, firm clay loam; and the lower part is reddish yellow, firm sandy clay loam. Sandy shale and sandstone bedrock is at a depth of about 30 inches. In a few areas sandstone fragments are on the surface. In some areas the depth to bedrock is more than 40 inches.

Included with this soil in mapping are small areas of Edalgo, Hedville, and Wells soils on side slopes. Edalgo soils are in positions on the side slopes similar to those of the Lancaster soil. They are more clayey in the subsoil than the Lancaster soil. The somewhat excessively drained Hedville soils are in the steeper areas. They are less than 20 inches deep over sandstone. Wells soils are more than 40 inches deep over sandstone. They are on the lower side slopes. Included soils make up about 10 percent of the map unit.

Permeability is moderate in the Lancaster soil, and surface runoff is medium. Available water capacity is moderate. Organic matter content also is moderate, and natural fertility is medium. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. Root penetration is restricted by the sandy shale and sandstone bedrock at a depth of 20 to 40 inches. The shrink-swell potential is moderate in the subsoil.

Most of the acreage is used as range. Some areas are used for cultivated crops. This soil is poorly suited to wheat, sorghum, and alfalfa. Water erosion is a severe hazard if cultivated crops are grown. Terraces, grassed waterways, contour farming, and conservation tillage help to prevent excessive soil loss. The depth to bedrock should be considered when terrace systems are designed.

This soil is suited to range. Droughtiness is a management concern. Because of the slope, water erosion is a hazard unless an adequate plant cover is maintained. Gullies form along some cattle trails. Fencing and other means of controlling livestock traffic patterns help to prevent gullying and give gullies time to

Figure 12.—Profile of Hedville loam. Sandstone bedrock is at a depth of 1.0 to 1.5 feet.

revegetate. Range seeding is needed to restore the productivity of abandoned cropland.

This soil is moderately well suited to dwellings. The shrink-swell potential is a limitation. Properly designing and reinforcing foundations and installing sealed foundation drains help to prevent the structural damage caused by shrinking and swelling. Slab-on-grade foundations should not be used.

Because of the depth to bedrock and seepage, this soil is poorly suited to septic tank absorption fields and sewage lagoons. The areas on the lower side slopes where the depth to bedrock is more than 40 inches are better sites for sewage disposal systems.

The land capability classification is IVe, and the range site is Loamy Upland.

Lh—Lancaster-Hedville complex, 3 to 20 percent slopes. These moderately sloping to moderately steep soils are on side slopes and narrow ridgetops in the uplands. Most areas are dissected by deeply entrenched drainageways. The moderately deep, well drained Lancaster soil is on the less sloping side slopes below the Hedville soil. The shallow, somewhat excessively drained Hedville soil is on narrow ridgetops and sharp slope breaks. Individual areas are irregular in shape and range from 10 to more than 3,000 acres in size. They are about 45 percent Lancaster soil and 30 percent Hedville soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Lancaster soil has a surface layer of dark grayish brown loam about 9 inches thick. The subsoil is about 21 inches thick. The upper part is brown, friable and firm clay loam, and the lower part is reddish yellow, firm sandy clay loam. Weathered sandy shale bedrock is at a depth of about 30 inches. In places the depth to bedrock is more than 40 inches.

Typically, the Hedville soil has a surface layer of grayish brown loam about 8 inches thick. The subsoil is reddish brown, friable gravelly loam about 9 inches thick. Sandstone bedrock is at a depth of about 17 inches (fig. 12). In places the surface layer has more rock fragments.

Included with these soils in mapping are small areas of Edalgo, Tobin, and Wells soils. Edalgo soils contain more clay in the subsoil than the Lancaster and Hedville soils. They are on side slopes below the Hedville soil. The occasionally flooded Tobin soils are on narrow flood plains. The deep Wells soils are on side slopes below the Hedville soil. Also included, on the steeper side slopes, are small areas where sandstone and clayey shale crop out. Included areas make up about 25 percent of the map unit.

Permeability is moderate in the Lancaster and Hedville soils. Surface runoff is rapid. Available water capacity is moderate in the Lancaster soil and very low in the Hedville soil. Natural fertility is medium in the

Lancaster soil and low in the Hedville soil. Root development is restricted below a depth of about 4 to 20 inches in the Hedville soil and below a depth of about 20 to 40 inches in the Lancaster soil. The shrink-swell potential is moderate in the subsoil of the Lancaster soil.

Nearly all areas are used as range. Because of a severe hazard of water erosion, the depth to bedrock, and rocks on or near the surface, these soils generally are unsuited to cultivated crops. They are better suited to range. Water erosion is a hazard if the range is overgrazed. In some areas gullies form along cattle trails. An adequate plant cover helps to prevent excessive soil loss. Fencing and other means of controlling livestock traffic patterns can be used to prevent the formation of gullies and to give gullies time to revegetate. Proper stocking rates, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season help to keep the range productive. Sites that are suitable for stock water ponds (fig. 13) generally are available in the larger areas of these soils. Many areas also are suitable for the development of springs.

The Lancaster soil is moderately well suited to dwellings. It is poorly suited to septic tank absorption fields and sewage lagoons. The shrink-swell potential, the depth to bedrock, and the slope are limitations on sites for dwellings. Properly designing and reinforcing foundations and installing sealed foundation drains help to prevent the structural damage caused by shrinking and swelling. Slab-on-grade foundations should not be used. The buildings should be designed so that they conform to the natural slope of the land. The bedrock is soft and can easily be excavated. The depth to bedrock and slope are limitations on sites for septic tank absorption fields and sewage lagoons. The deeper included soils are better sites for these uses.

The Hedville soil is generally unsuited to building site development because of the depth to bedrock and the slope. It is generally unsuited to septic tank absorption fields because of seepage, the depth to bedrock, and the slope.

The land capability classification is VIe. The Lancaster soil is in the Loamy Upland range site, and the Hedville soil is in the Shallow Sandstone range site.

Lm—Longford silt loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on broad slopes on ridges in the uplands. Individual areas are irregular in shape and range from about 10 to more than 200 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsurface layer also is dark grayish brown, friable silt loam. It is about 5 inches thick. The subsoil is about 34 inches thick. The upper part is brown, friable silty clay loam. The next part is reddish brown and yellowish red, firm silty clay. The lower part is reddish yellow, friable silty clay loam. The substratum to a depth of about 60 inches is light reddish brown, friable clay loam. In a few areas the subsoil is grayish brown, calcareous silty clay loam.

Included with this soil in mapping are small areas of Crete and Geary soils on side slopes. Crete soils have a subsoil that is browner than that of the Longford soil, and Geary soils have one that is less clayey. Included soils make up about 10 percent of the map unit.

Permeability is slow in the Longford soil, and surface runoff is medium. Available water capacity is high. Organic matter content is moderate, and natural fertility is high. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is high in the subsoil.

Most of the acreage is cultivated. This soil is well suited to wheat, sorghum, and alfalfa. If cultivated crops are grown, erosion is a hazard. Terraces, grassed waterways, contour farming, a protective cover of crop residue, and conservation tillage help to control erosion (fig. 14), maintain the content of organic matter, and improve tilth.

This soil is poorly suited to dwellings because of the shrink-swell potential. Properly designing and reinforcing foundations and installing sealed foundation drains help to prevent the structural damage caused by shrinking and swelling. Slab-on-grade foundations should not be used.

This soil is poorly suited to septic tank absorption fields and is moderately well suited to sewage lagoons. The slow permeability restricts the absorption of effluent in septic tank absorption fields. Enlarging the field or installing the distribution lines below the clayey subsoil, however, helps to overcome this limitation. The slope is a limitation on sites for sewage lagoons. Some land shaping commonly is needed.

The land capability classification is IIe, and the range site is Loamy Upland.

Lo—Longford silt loam, 3 to 7 percent slopes. This deep, moderately sloping, well drained soil is on the sides of upland ridges. Individual areas are irregular in shape and range from about 10 to more than 700 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsurface layer also is dark grayish brown, friable silt loam. It is about 5 inches thick. The subsoil is about 34 inches thick. The upper part is brown, friable silty clay loam. The next part is reddish brown and yellowish red, firm

Figure 13.—A pond that provides water for livestock in an area of Lancaster-Hedville complex, 3 to 20 percent slopes.

silty clay. The lower part is reddish yellow, friable silty clay loam. The substratum to a depth of about 60 inches is light reddish brown, friable clay loam. In a few areas the subsoil is calcareous. In places the surface layer is brown and reddish brown silty clay loam.

Included with this soil in mapping are small areas of the moderately deep Clime, Edalgo, and Lancaster soils on the steeper side slopes. These soils make up about 15 percent of the map unit.

Permeability is slow in the Longford soil, and surface runoff is medium. Available water capacity is high. Organic matter content is moderate, and natural fertility is high. The surface layer is friable and can be tilled throughout a fairly wide range in moisture content. The shrink-swell potential is high in the subsoil.

Most of the acreage is cultivated. This soil is moderately well suited to wheat, sorghum, and alfalfa. If cultivated crops are grown, erosion is a hazard. Terraces, grassed waterways, contour farming (fig. 15), a protective cover of crop residue, and conservation

tillage help to control erosion, maintain the content of organic matter, and improve tilth.

This soil is poorly suited to dwellings because of the shrink-swell potential. Properly designing and reinforcing foundations and installing sealed foundation drains help to prevent the structural damage caused by shrinking and swelling. Slab-on-grade foundations should not be used.

This soil is poorly suited to septic tank absorption fields and is moderately well suited to sewage lagoons. The slow permeability restricts the absorption of effluent in septic tank absorption fields. Enlarging the field or installing the distribution lines below the clayey subsoil, however, helps to overcome this limitation. The slope is a limitation on sites for sewage lagoons. Some land shaping commonly is needed.

The land capability classification is IIIe, and the range site is Loamy Upland.

Mc—McCook silt loam. This deep, nearly level, well drained soil is on stream terraces. It is subject to rare flooding. Slopes range from 0 to 2 percent. Individual areas are long and irregularly shaped and range from 10 to several hundred acres in size.

Typically, the surface layer is dark grayish brown, calcareous silt loam about 5 inches thick. The subsurface layer is grayish brown, friable, calcareous silt loam about 6 inches thick. The next layer is light brownish gray, friable, calcareous silt loam about 6 inches thick. The upper part of the substratum is very pale brown, very friable, calcareous very fine sandy loam that has a few thin strata of more silty material.

Figure 14.—A grassed waterway, contour farming, and terraces in an area of Longford silt loam, 1 to 3 percent slopes.

Figure 15.—An area of Longford silt loam, 3 to 7 percent slopes, where contour farming has helped to rebuild a terrace.

The lower part to a depth of about 60 inches is light gray, very friable, calcareous silt loam. In places, the surface soil is more than 20 inches thick and the soil is more silty and less sandy throughout. In some small areas the surface soil is less than 7 inches thick.

Included with this soil in mapping are small areas of the moderately well drained, clayey New Cambria soils. These soils are in the slightly lower, more concave areas. Also included are areas of the moderately sloping McCook soils on escarpments and in old stream meander channels. Included soils make up about 15 percent of the map unit.

Permeability is moderate in the McCook soil, and surface runoff is slow. Available water capacity is high. Natural fertility also is high, and organic matter content is medium. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content.

Nearly all of the acreage is used for cultivated crops. This soil is well suited to wheat, grain sorghum, forage sorghum, and alfalfa. Applying a system of conservation tillage that leaves all or part of the crop residue on the surface and adding other organic material improve fertility and tilth and increase the rate of water infiltration.

Edge areas where cropland is adjacent to range or woodland provide habitat for many kinds of wildlife, including deer, quail, rabbits, squirrels, and numerous songbirds. The habitat can be improved by planting trees or shrubs or by leaving small areas of unharvested crops along the edges of the cropland.

This soil is poorly suited to dwellings and moderately well suited to septic tank absorption fields. The flooding is a hazard affecting both uses. Dikes, levees, and other structures can reduce the hazard of flooding. Onsite inspection and knowledge of the flooding history of the area are needed when building sites are selected. The soil is only moderately well suited to

sewage lagoons because of seepage. Sealing the lagoon helps to control seepage.

The land capability classification is I, and the range site is Loamy Terrace.

Ne—New Cambria silty clay. This deep, nearly level, moderately well drained soil is on stream terraces. It is subject to rare flooding. Slopes range from 0 to 2 percent. Individual areas are irregular in shape and range from 10 to 900 acres in size.

Typically, the surface layer is dark grayish brown, calcareous silty clay about 6 inches thick. The subsurface layer is dark gray, very firm, calcareous silty clay about 8 inches thick. The subsoil is very firm, calcareous silty clay about 26 inches thick. The upper part is dark gray, and the lower part is grayish brown. The substratum to a depth of about 60 inches is light brownish gray, calcareous silty clay loam. In places the depth to calcareous material is more than 10 inches.

Included with this soil in mapping are small areas of Hord, McCook, and Roxbury soils. These soils are less clayey than the New Cambria soil. They are on slightly convex, low ridges. They make up about 15 percent of the map unit.

Permeability is slow in the New Cambria soil. Runoff also is slow. Available water capacity is moderate. Organic matter content also is moderate, and natural fertility is medium. The soil is sticky when wet and very hard when dry and cannot be easily tilled. If the soil is tilled when too wet, tilth further deteriorates and large clods form on the surface. The shrink-swell potential is high.

Most of the acreage is used for cultivated crops. This soil is well suited to wheat, grain sorghum, forage sorghum, and alfalfa. Planting and tillage are delayed during some wet periods. Drainage ditches help to remove excess surface water. In periods when the amount of rainfall is low, the clayey subsoil releases moisture slowly to plants. A system of conservation tillage that leaves all or part of the crop residue on the surface increases the rate of water infiltration, improves tilth, and conserves moisture.

This soil is poorly suited to dwellings because of the flooding and the shrink-swell potential. Dikes, levees, and other structures can reduce the hazard of flooding. Onsite inspection and knowledge of the flooding history of the area are needed when building sites are selected. Properly designing and reinforcing foundations and installing sealed foundation drains help to prevent the structural damage caused by shrinking and swelling. Slab-on-grade foundations should not be used.

This soil is well suited to sewage lagoons but is poorly suited to septic tank absorption fields. The slow permeability restricts the absorption of effluent in septic tank absorption fields. Enlarging the field or installing the distribution lines below the clayey subsoil, however, helps to overcome this limitation.

The land capability classification is IIs, and the range site is Clay Terrace.

Ot—Ortello fine sandy loam, 2 to 6 percent slopes. This deep, moderately sloping, well drained soil is on uplands and high terraces. Individual areas are irregular in shape and range from 5 to 200 acres in size.

Typically, the surface layer is brown fine sandy loam about 6 inches thick. The subsurface layer is brown, very friable fine sandy loam about 8 inches thick. The subsoil is brown, very friable fine sandy loam about 17 inches thick. The substratum to a depth of about 60 inches is very pale brown loamy fine sand. In some areas the surface soil is eroded and is brown or pale brown.

Included with this soil in mapping are a few small areas of Wells soils. These soils contain less sand than the Ortello soil. They are in the more nearly level areas. They make up about 5 percent of the map unit.

Permeability is moderately rapid in the Ortello soil, and surface runoff is medium. Available water capacity is moderate. Natural fertility is medium. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content.

Most of the acreage is used for cultivated crops. This soil is moderately well suited to wheat, grain sorghum, forage sorghum, and alfalfa. Soil blowing and water erosion are hazards. Planting winter cover crops and applying a system of conservation tillage that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve fertility and tilth and help to control soil blowing.

Edge areas where cropland is adjacent to range or woodland provide habitat for many kinds of wildlife, including deer, quail, rabbits, squirrels, and numerous songbirds. The habitat can be improved by planting trees or shrubs or by leaving small areas of unharvested crops along the edges of the cropland.

This soil is well suited to dwellings but is poorly suited to septic tank absorption fields and sewage lagoons. It readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity can result in the pollution of ground water. The filtering capacity is better in the included soils that have a lower content of sand. Seepage is a limitation on sites for sewage lagoons. It can be controlled by sealing the lagoon.

The land capability classification is IIIe, and the range site is Sandy.

Ov—Orthents, clayey. These soils are in areas where soil material has been excavated and used as fill material for roads. They are on uplands and bottom land. Areas generally are nearly level but have short, steep side slopes. Most areas are excavated to a depth of more than 4 feet, and a few are excavated to shale bedrock. Individual areas range from 5 to 10 acres in size.

In most places water covers the surface during part of the growing season. The soil material that remains in some areas varies from place to place. It is generally clayey, however, and has mottled gray colors. Organic matter content and fertility are low. Tilth is poor.

These soils are generally unsuited to cultivation and to most other uses. The surface generally is bare or only sparsely vegetated. In areas where surface drainage is good, trees and grasses can be planted. If vegetation is reestablished, the soils are well suited to wildlife habitat. Planting woody species improves the diversity of the vegetation. The more diverse vegetation commonly attracts additional wildlife species.

No land capability classification or range site is assigned.

Ro—Roxbury silt loam. This deep, nearly level, well drained soil is on terraces along the larger streams in the county. It is subject to rare flooding. Slopes range from 0 to 2 percent. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is dark grayish brown, calcareous silt loam about 7 inches thick. The subsurface layer is grayish brown, friable, calcareous silt loam about 19 inches thick. The substratum to a depth of about 60 inches is calcareous silt loam. The upper part is grayish brown and friable, and the lower part is light brownish gray. In some places the subsoil is very fine sandy loam. In other places the surface soil is less than 20 inches thick. In some areas the depth to lime is more than 15 inches.

Included with this soil in mapping are small areas of McCook soils. These soils are less clayey than the Roxbury soil. Also, they are in higher, more convex areas. They make up about 10 percent of the map unit.

Permeability is moderate in the Roxbury soil, and surface runoff is slow. Available water capacity is high. Natural fertility also is high. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate in the subsoil.

Most areas are used for cultivated crops. This soil is well suited to grain sorghum, forage sorghum, wheat, and alfalfa. Applying a system of conservation tillage that leaves all or part of the crop residue on the surface and adding other organic material improve tilth and fertility and increase the rate of water infiltration.

This soil is poorly suited to dwellings and is moderately well suited to septic tank absorption fields. The flooding is a hazard affecting both uses. Dikes, levees, and other structures can reduce the hazard of flooding. Onsite inspection and knowledge of the flooding history of the area are needed when building sites are selected. The soil is only moderately well suited to sewage lagoons because of seepage. Sealing the lagoon helps to control seepage.

The land capability classification is I, and the range site is Loamy Terrace.

Sm—Smolan silt loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is on the tops and upper sides of ridges in the uplands. Individual areas are irregular in shape and range from about 10 to more than 100 acres in size.

Typically, the surface layer is grayish brown silt loam about 6 inches thick. The subsurface layer is dark grayish brown, friable silty clay loam about 6 inches thick. The subsoil is about 34 inches thick. The upper part is grayish brown, firm silty clay loam. The next part is grayish brown and brown, very firm and firm silty clay. The lower part is reddish brown, friable silty clay loam. The substratum to a depth of about 60 inches is reddish brown, friable silty clay loam. In some places the soil is dark to a depth of less than 20 inches. In other places the subsoil is less red.

Permeability is slow. Surface runoff also is slow. Available water capacity is high. Natural fertility also is high, and organic matter content is moderate. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is high in the subsoil.

Most areas are used for cultivated crops. This soil is well suited to wheat, sorghum, and alfalfa. The clayey subsoil somewhat restricts the movement of water into the soil and releases moisture slowly to plants. A system of conservation tillage that leaves all or part of the crop residue on the surface conserves moisture and increases the content of organic matter.

This soil is poorly suited to dwellings. The shrink-swell potential is a limitation. Properly designing and reinforcing foundations and installing sealed foundation drains help to prevent the structural damage caused by shrinking and swelling. Slab-on-grade foundations should not be used.

This soil is poorly suited to septic tank absorption fields because the slow permeability restricts the absorption of effluent. Enlarging the field, however, helps to overcome this limitation. The soil is only moderately well suited to sewage lagoons because of

seepage. Sealing the lagoon helps to control seepage.
The land capability classification is I, and the range site is Loamy Upland.

So—Solomon silty clay, occasionally flooded. This deep, nearly level, poorly drained soil is in depressions and old meander scars on flood plains. It is occasionally flooded. Slopes range from 0 to 2 percent. Individual areas are long and narrow and range from 5 to 200 acres in size.

Typically, the surface layer is very dark gray, calcareous silty clay about 4 inches thick. The subsurface layer is black, calcareous, very firm silty clay about 12 inches thick. The subsoil is very firm, calcareous silty clay about 34 inches thick. The upper part is very dark gray, and the lower part is very dark gray and dark gray and is mottled. The substratum to a depth of about 60 inches is dark gray, mottled, calcareous silty clay. In some areas the surface layer, the subsurface layer, and the upper part of the subsoil are not calcareous.

Included with this soil in mapping are small areas of the moderately well drained, nearly level New Cambria and Sutphen soils. The clayey New Cambria soils are on convex slopes. Sutphen soils are on concave slopes. They are noncalcareous in the surface soil and subsoil. Included soils make up about 15 percent of the map unit.

Permeability is very slow in the Solomon soil. Surface runoff also is very slow. Water ponds on the surface in some areas. The seasonal high water table is within a depth of 2 feet late in winter and early in spring. Available water capacity is moderate. Natural fertility is medium. The soil is sticky when wet and very hard when dry and cannot be easily tilled. The shrink-swell potential is high.

Most areas are used as cropland. This soil is moderately well suited to wheat, sorghum, soybeans, and alfalfa. Wetness is a limitation in spring and early in summer, and droughtiness is a limitation late in summer. A system of conservation tillage that leaves all or part of the crop residue on the surface improves the moisture-supplying capacity by increasing the rate of water infiltration. It also improves fertility and tilth.

This soil is well suited to range. Overgrazing reduces the vigor of the grasses. Proper stocking rates, a uniform distribution of grazing, and timely deferment of grazing help to keep the range in good condition.

This soil is generally unsuited to building site development because of the flooding, the wetness, the very slow permeability, and the shrink-swell potential.

The land capability classification is IIIw, and the range site is Clay Lowland.

St—Sutphen silty clay, occasionally flooded. This deep, nearly level, moderately well drained soil generally is in slight depressions on the higher parts of flood plains. It is occasionally flooded. Slopes are 0 to 1 percent. Individual areas are irregular in shape and range from 10 to more than 1,000 acres in size.

Typically, the surface layer is very dark gray silty clay about 6 inches thick. The subsurface layer is very dark gray, very firm silty clay about 29 inches thick. The subsoil is dark gray, very firm, calcareous silty clay about 12 inches thick. The substratum to a depth of about 60 inches is brown, calcareous silty clay that has concretions of lime.

Included with this soil in mapping are small areas of Detroit, New Cambria, and Solomon soils. The moderately well drained Detroit and New Cambria soils are in the higher convex areas along streams. Detroit soils contain less clay in the surface layer than the Sutphen soil. New Cambria soils are calcareous. The poorly drained, nearly level Solomon soils are in concave areas. Also included are small areas of saline soils or slickspots. Included soils make up about 10 percent of the map unit.

Permeability is very slow in the Sutphen soil, and surface runoff is slow. Available water capacity is moderate. Natural fertility is medium. The soil is sticky when wet and very hard when dry and cannot be easily tilled. The shrink-swell potential is high.

Most areas are used as cropland. This soil is well suited to wheat, sorghum, soybeans, and alfalfa. Wetness is a limitation in spring, and droughtiness is a limitation late in summer. A system of conservation tillage that leaves all or part of the crop residue on the surface increases the rate of water infiltration and improves fertility and tilth.

This soil is generally unsuited to building site development because of the flooding, the very slow permeability, and the shrink-swell potential.

The land capability classification is IIw, and the range site is Clay Lowland.

To—Tobin silt loam, occasionally flooded. This deep, nearly level, well drained soil is on flood plains along small creeks and drainageways. It is occasionally flooded. Slopes range from 0 to 2 percent. Individual areas are 200 to 800 feet wide, ¼ mile to several miles long, and 20 to several hundred acres in size.

Typically, the surface layer is dark grayish brown silt loam about 20 inches thick. The subsurface layer is grayish brown, friable silt loam about 18 inches thick. The substratum to a depth of about 60 inches is brown and pale brown silt loam. In a few areas the surface layer is calcareous. In places it is loam.

Included with this soil in mapping are a few areas of

Cozad soils and some areas along stream channels that generally are not cultivated because of cutbanks and steep escarpments. Cozad soils contain more sand than the Tobin soil and have a thinner surface layer. They are in the slightly higher convex areas. Also included are Hord soils and saline spots. Hord soils are on mounds at the higher elevations and are subject to rare flooding. Included soils make up about 5 percent of the map unit.

Permeability is moderate in the Tobin soil, and surface runoff is slow. Available water capacity is high. Natural fertility also is high. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate in the subsoil.

About half of the acreage is used for cultivated crops. The rest generally is used as range. This soil is well suited to wheat, grain sorghum, forage sorghum, and alfalfa. Flooding delays planting and harvesting and damages crops in some years, but in other years the extra moisture may increase crop yields. Overcoming the hazard of flooding is difficult without major flood-control measures. Applying a system of conservation tillage that leaves all or part of the crop residue on the surface and adding other organic material improve tilth and fertility and increase the rate of water infiltration.

This soil is suited to range. The native vegetation is dominantly mid and tall grasses. In areas that are continually overgrazed, these grasses are replaced by less productive plants. Proper stocking rates, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season help to keep the range productive. In areas used for hay, early mowing allows grasses to recover before the first frost.

Edge areas where cropland is adjacent to range or woodland provide habitat for many kinds of wildlife, including deer, quail, and numerous songbirds. The habitat can be improved by planting shrubs or trees or by leaving small areas of unharvested crops along the edges of the cropland.

This soil is generally unsuited to building site development and sanitary facilities because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is IIw, and the range site is Loamy Lowland.

Wr—Wells loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on ridges and side slopes in the uplands. Individual areas are irregular in shape and range from 10 to 400 acres in size.

Typically, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is about 40 inches thick. The upper part is brown, friable loam; the next part is yellowish red and reddish yellow, firm clay loam; and the lower part is reddish yellow, friable clay loam. The substratum to a depth of about 60 inches is reddish yellow loam. In places the soil is more silty. In some areas the depth to bedrock ranges from 40 to 60 inches.

Included with this soil in mapping are small areas of Crete, Lancaster, and Ortello soils. Crete soils contain more clay in the subsoil than the Wells soil. They are on the upper side slopes. Lancaster soils are underlain by sandy shale and sandstone bedrock at a depth of 20 to 40 inches. They are on the lower side slopes. Ortello soils contain more sand than the Wells soil. They are in the more hummocky areas. Included soils make up about 10 percent of the map unit.

Permeability is moderate in the Wells soil, and surface runoff is medium. Available water capacity is high. Natural fertility also is high. The surface layer is very friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate in the subsoil.

Nearly all of the acreage is used for cultivated crops. This soil is well suited to wheat, grain sorghum, and alfalfa. Water erosion is a hazard if cultivated crops are grown. Terraces, grassed waterways, contour farming, and a system of conservation tillage that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration.

This soil is moderately well suited to dwellings and sewage lagoons. It is well suited to septic tank absorption fields. The shrink-swell potential in the subsoil is a limitation on sites for dwellings. Properly designing and reinforcing foundations and installing sealed foundation drains help to prevent the structural damage caused by shrinking and swelling. Slab-on-grade foundations should not be used. Seepage and slope are limitations on sites for sewage lagoons. Seepage can be controlled by sealing the lagoon. If the less sloping areas are selected as sites for lagoons, less leveling and banking will be needed during construction.

The land capability classification is IIe, and the range site is Loamy Upland.

Ws—Wells loam, 3 to 7 percent slopes. This deep, moderately sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is about 40 inches thick. The upper part is brown, friable loam; the next part is yellowish red and reddish yellow, firm clay

loam; and the lower part is reddish yellow, friable clay loam. The substratum to a depth of about 60 inches is reddish yellow loam. In places the soil is more silty. In areas where the subsoil has been mixed with the surface layer by tillage, the surface layer is light brown sandy clay loam. In some areas the depth to bedrock ranges from 40 to 60 inches.

Included with this soil in mapping are small areas of Crete, Edalgo, Lancaster, and Ortello soils. The deep Crete soils are more clayey than the Wells soil. They are in the more nearly level areas. The moderately deep Edalgo and Lancaster soils are on the lower side slopes. Ortello soils contain more sand than the Wells soil. They are in the more hummocky areas. Included soils make up about 20 percent of the map unit.

Permeability is moderate in the Wells soil, and surface runoff is medium. Available water capacity is high. Natural fertility also is high. The surface layer is very friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate in the subsoil.

About half of the acreage is used for cultivated crops or is abandoned cropland. The other half is used as range. This soil is moderately well suited to wheat, grain sorghum, and forage sorghum. Water erosion is a hazard if cultivated crops are grown. Terraces, grassed waterways, contour farming, and a system of conservation tillage that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration.

This soil is suited to range. Water erosion is a hazard if the range is overgrazed. In some areas gullies form along cattle trails. An adequate plant cover helps to prevent excessive soil loss. Fencing and other means of controlling livestock traffic patterns can be used to prevent the formation of gullies and to give gullies time to revegetate. Proper stocking rates, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season help to keep the range productive. Seeding of native grasses is needed to restore productivity on abandoned cropland. In areas used for hay, early mowing allows grasses to recover before the first frost.

Edge areas where cropland is adjacent to range can be managed as habitat for upland wildlife, such as pheasants. The habitat can be improved by planting trees or shrubs or by leaving small areas of unharvested crops along the edges of the cropland.

This soil is moderately well suited to dwellings and sewage lagoons. It is well suited to septic tank absorption fields. The shrink-swell potential in the subsoil is a limitation on sites for dwellings. Properly designing and reinforcing foundations and installing sealed foundation drains help to prevent the structural damage caused by shrinking and swelling. Slab-on-grade foundations should not be used. Seepage and slope are limitations on sites for sewage lagoons. Seepage can be controlled by sealing the lagoon. If the less sloping areas are selected as sites for lagoons, less leveling and banking will be needed during construction.

The land capability classification is IIIe, and the range site is Loamy Upland.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 336,080 acres in the survey area, or nearly 73 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county, but most are in the central and eastern parts. About 225,000 acres of the prime farmland is used for crops, mainly alfalfa, wheat,

and grain sorghum. The crops grown on this land account for an estimated two-thirds of the county's total agricultural income each year.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help to prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

The soils in the survey area are assigned to a capability classification and a range site at the end of each map unit description and in tables 6 and 7. The capability classification and range site for each map unit also are shown in the section "Interpretive Groups," which follows the tables at the back of this survey.

Cropland

Jerry B. Lee, conservation agronom st, Soil Conservation Service, helped prepare this section.

General management needed for crops is suggested in this section. The crops best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 225,000 acres in Saline County, or 49 percent of the total acreage, is used for cultivated crops. During the period 1975 to 1984, wheat was grown on about 75 percent of the cropland, grain sorghum on 12 percent, and corn, alfalfa, soybeans, and oats on 13 percent *(6)*.

Crop production can be increased on most farms by applying the latest technology. This soil survey can facilitate the application of such technology. The main concerns in managing the soils in Saline County for crops are controlling water erosion, making the most efficient use of the available water, and maintaining soil fertility and tilth. Also, soil blowing is a hazard on a few soils in the county.

Water erosion is the major hazard on about 60 percent of the cropland in the county. Most of the erosion occurs on soils that have a slope of more than 1 or 2 percent. Examples are Wells, Geary, Crete, Clime, Edalgo, Lancaster, Irwin, and Longford soils.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Secondly, erosion pollutes streams with sediments, nutrients, and pesticides. Control of erosion minimizes this pollution and thus improves the quality of water.

Erosion-control practices can provide a protective

cover, reduce the runoff rate, and increase the rate of water infiltration. A cropping system that keeps a plant cover on the surface for extended periods and a conservation tillage system that keeps crop residue on the surface helps to control water erosion and soil blowing and preserves the productive capacity of the soils.

Conservation tillage is a planting and tillage system that leaves a protective cover of crop residue on the soil and thus keeps water erosion and soil blowing within tolerable limits. Examples are no-till and mulch-till. In areas where a no-till system is applied, crops are planted in undisturbed soil and nearly all of the residue from the preceding crop is left on the surface. In areas where a mulch-till system is applied, a seedbed is prepared with stubble mulch plows, chisels, field cultivators, disks, or blades that leave enough crop residue on the surface for erosion control.

Terraces, diversions, grassed waterways, and contour farming should be used in combination with conservation tillage on soils that have slopes of more than 2 percent. They also are needed on soils that have slopes of more than 1 percent if a system of conservation tillage is not applied. Terraces and diversions shorten the length of slopes, intercept concentrated flows, minimize the formation of gullies, reduce the runoff rate, and help to control erosion. They are most practical on deep, well drained soils that have uniform slopes, including Crete, Geary, Irwin, Longford, and Wells soils. Clime, Edalgo, and Lancaster soils are somewhat less well suited to terraces because they are moderately deep over bedrock. Contour farming should generally be used in combination with terraces. It is best suited to soils that have smooth, uniform slopes and are suitable for terracing.

Organic matter is a storehouse of available plant nutrients. It increases the rate of water intake, helps to prevent surface crusting, helps to control erosion, and promotes good tilth. Most of the soils in the county that are used for crops have a loamy surface layer. During periods of intensive rainfall, a crust forms on the surface. When dry, the crusted surface becomes nearly impervious to water. As a result, the runoff rate is increased. Regularly adding organic material and leaving crop residue on the surface minimize surface crusting, increase the rate of water infiltration, and help to control runoff and erosion.

Plants on most of the arable soils in the county respond well to applications of nitrate and phosphate fertilizer. On all soils the amount of fertilizer to be applied should be based on the results of soil tests, the needs of the crop, the expected level of yields, and the experience of farmers. The Cooperative Extension Service can help to determine the kind and amount of fertilizer needed.

Information about the design of erosion-control practices is available at the local office of the Soil Conservation Service. The latest information about growing crops can be obtained from the Cooperative Extension Service or the Soil Conservation Service.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations also are considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The

criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations or hazards that restrict their use.

Class II soils have moderate limitations or hazards that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations or hazards that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations or hazards that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations or hazards that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations or hazards that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations or hazards that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units," in the yields table, and in the section "Interpretive Groups."

Rangeland

Mike Meurisse, range conservationist, Soil Conservation Service, helped prepare this section.

About 175,000 acres in Saline County, or 38 percent of the total acreage, is rangeland. About 30 percent of the value of agricultural products in the county is derived from the sale of cattle.

Most of the livestock farms and ranches in the county are cow-calf enterprises. Much of the rangeland occurs as small tracts intermingled with larger areas of cropland. Large ranches are more common in the western third of the county than in other areas. Some farmers and ranchers extend the grazing season by planting cool-season tame pasture grasses, principally bromegrass. Many also supplement the rangeland forage with crop residue. During winter, protein concentrates are used to supplement low-quality, dormant forage. Hay is fed to livestock for short periods during most winters. Native grass pastures are covered with snow during these periods.

Because of soil characteristics and the amount of precipitation, the county is in a transition zone between the Mixed Grass Prairie to the west and Tall Grass Prairie to the east. The dominant grass species are most like those of the Tall Grass Prairie. These plant communities are dominated by big bluestem, little bluestem, indiangrass, switchgrass, and sideoats grama.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 7 shows, for nearly all of the soils, the range site; the total annual production of vegetation in favorable, average, and unfavorable years. Only those soils that are used as rangeland or are suited to rangeland are listed. An explanation of the column headings in table 7 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a

seasonal high water table also are important.

Potential annual production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, average, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Overgrazing has reduced forage production in some areas of the county. A management system that includes proper grazing use and a uniform distribution of grazing help to keep the range productive. Combined with a planned grazing system, measures that control brush, and reseeding of marginal cropland and overgrazed areas, these measures also improve the range.

The soils in the survey area are assigned to the following range sites: Clay Lowland, Clay Terrace, Clay Upland, Limy Upland, Loamy Lowland, Loamy Terrace, Loamy Upland, Saline Lowland, Sandy, Sandy Lowland, and Shallow Sandstone. These sites are described in the paragraphs that follow.

Clay Lowland range site. The soils in this range site are on flood plains and terraces and are occasionally flooded. The potential native vegetation is tall prairie grasses. Typically, the dominant grasses are big bluestem, which makes up about 35 percent of the vegetation; prairie cordgrass, 15 percent; indiangrass, 10 percent; switchgrass, 10 percent; western wheatgrass, 5 percent; eastern gamagrass, 5 percent; tall dropseed, 5 percent; and little bluestem, 5 percent. Other grasses are blue grama, sideoats grama, Canada wildrye, and green muhly. Forbs, such as American licorice, Illinois bundleflower, Maximilian sunflower, Baldwin ironweed, and western ragweed, make up about 10 percent of the vegetation. In some areas the site has small amounts of green ash, hackberry, indigobush, and cottonwood.

Because of extra moisture and the deeper rooted plants, this site is a preferred grazing area, especially during periods of moisture stress. Overgrazing reduces the abundance of big bluestem, prairie cordgrass, indiangrass, switchgrass, and Canada wildrye and of palatable forbs, such as American licorice, Illinois bundleflower, and Maximilian sunflower. Western wheatgrass, blue grama, buffalograss, tall dropseed, Baldwin ironweed, and western ragweed are the principal increasers.

Where overgrazing has continued for a few years, the site commonly can be returned to near its potential by management that includes proper grazing use and a scheduled deferment of grazing during the growing season. If the site has been overgrazed for a long period, recovery may be slow even when good management is applied. Under these conditions, tall dropseed generally becomes the dominant grass and the site has significant amounts of Japanese brome, little barley, buffalograss, and sideoats grama.

Clay Terrace range site. The soils in this range site are on stream terraces and are subject to rare flooding. The potential native vegetation is mixed prairie grasses. Typically, the dominant grasses are big bluestem, which makes up 30 percent of the vegetation; switchgrass, 15 percent; little bluestem, 15 percent; sideoats grama, 15 percent; western wheatgrass, 10 percent; and tall dropseed, 5 percent. Other grasses are sideoats grama, blue grama, tall dropseed, and buffalograss. Forbs, such as heath aster, goldenrod, Louisiana sagewort, nineanther dalea, Illinois bundleflower, and western ragweed, make up about 10 percent of the vegetation.

Because of additional water from the adjacent sloping areas, the production potential is higher on these soils than on similar soils in the uplands. Continuous grazing during wet periods in spring or early summer may cause compaction, which restricts water intake and root development. The taller grasses cannot

easily survive if the site is subject to continuous grazing during these periods or to heavy grazing throughout the growing season.

Blue grama and western wheatgrass tend to dominate overgrazed areas. Continuous overgrazing allows ragweed, buffalograss, little barley, and kochia to dominate the site. Once these plants are dominant, most of the taller grasses have been eliminated and management is slow to return the site to its productive potential. Grazing management that includes proper stocking rates and a flexible grazing system helps to maintain the site or restores it nearly to its potential.

Clay Upland range site. The potential native vegetation on this range site is mixed prairie grasses. Typically, the dominant grasses are big bluestem, which makes up about 30 percent of the vegetation; little bluestem, 15 percent; switchgrass, 15 percent; indiangrass, 10 percent; sideoats grama, 10 percent; blue grama, 5 percent; western wheatgrass, 5 percent; and tall dropseed, 5 percent. Other grasses are porcupinegrass, prairie junegrass, purple lovegrass, Canada wildrye, and rosette panicum. Forbs, such as aromatic aster, blue wild indigo, Louisiana sagewort, green antelopehorn, slimflower scurfpea, dotted gayfeather, daisy fleabane, heath aster, and western ragweed, make up about 5 percent of the vegetation. Leadplant is common on this site but generally in small amounts.

In most areas overgrazing on this site initially reduces the abundance of big bluestem, indiangrass, and little bluestem. Under these conditions, sideoats grama, buffalograss, and blue grama become the major increaser species. After periods of continued overgrazing, blue grama, tall dropseed, sideoats grama, Kentucky bluegrass, buffalograss, and western wheatgrass become the dominant species. Remnants of the preferred grass species tend to survive unless destructive grazing occurs.

Once most of the taller species are removed from the site through grazing pressure and dry weather cycles, returning the site to its potential native vegetation is extremely difficult and may take several decades. Where remnant stands of the taller species are evident, the site can be returned to its production potential by proper stocking rates and a grazing system that includes a scheduled deferment of grazing during the growing season. Maintaining significant amounts of big bluestem and little bluestem is difficult without a grazing management plan that includes rest periods.

Limy Upland range site. The soils in this range site are on gently sloping to steep uplands. The potential native vegetation is mixed prairie grasses. Typically, the dominant grasses are big bluestem, which makes up about 35 percent of the vegetation; little bluestem, 20 percent; sideoats grama, 15 percent; indiangrass, 10 percent; and switchgrass, 5 percent. Other grasses are tall dropseed, western wheatgrass, and hairy grama. Forbs, such as blacksamson, catclaw sensitivebrier, dotted gayfeather, heath aster, purple prairie-clover, slimflower scurfpea, and western ragweed, make up about 15 percent of the vegetation. Leadplant, pricklypear, buckbrush, and aromatic sumac grow in small amounts.

In overgrazed areas big bluestem, indiangrass, and switchgrass are the major decreasers. Little bluestem initially increases in abundance but decreases with continued overuse. Sideoats grama, hairy grama, tall dropseed, Louisiana sagewort, heath aster, and western ragweed are other increasers. Severe overgrazing results in a pasture of short grasses and weedy forbs.

In the steeper, less accessible areas, the preferred grass species generally are not excessively grazed. These areas are seed sources for the better forage plants after long periods of drought, overgrazing, or both. Grazing distribution is a problem because the livestock prefer the more gently sloping areas. Measures that distribute the grazing evenly, proper stocking rates, and a scheduled deferment of grazing during the growing season help to restore this site to its production potential. Properly locating salting and watering facilities helps to achieve an even distribution of grazing. Other management measures, such as properly located fences and a planned grazing system, also are beneficial.

Loamy Lowland range site. The soils in this range site are on flood plains and terraces and are rarely or occasionally flooded. The potential native vegetation is tall prairie grasses. Typically, the dominant grasses are big bluestem, which makes up about 40 percent of the vegetation; eastern gamagrass, 15 percent; indiangrass, 10 percent; switchgrass, 10 percent; prairie cordgrass, 5 percent; and little bluegrass, 5 percent. Other grasses are sideoats grama, tall dropseed, western wheatgrass, Canada wildrye, and red threeawn. Forbs, such as American licorice, catclaw sensitivebrier, Illinois bundleflower, Maximilian sunflower, pitcher sage, Baldwin ironweed, heath aster, Louisiana sagewort, and western ragweed, make up about 10 percent of the vegetation. American plum, green ash, hackberry, indigobush, leadplant, and cottonwood make up about 5 percent.

Because of extra moisture and the deeper rooted plants, this site is a preferred grazing area, especially during periods of moisture stress. Overgrazing reduces the abundance of big bluestem, eastern gamagrass,

indiangrass, switchgrass, and Canada wildrye and of palatable forbs, such as American licorice, catclaw sensitivebrier, Illinois bundleflower, and Maximilian sunflower. Western wheatgrass, blue grama, red threeawn, tall dropseed, Baldwin ironweed, western ragweed, and scarlet globemallow are the principal increasers.

Where overgrazing has continued for a few years, the site commonly can be returned to near its potential by management that includes proper grazing use and a scheduled deferment of grazing during the growing season. If the site has been overgrazed for a long period, recovery may be slow even when good management is applied. Under these conditions, western wheatgrass generally becomes the dominant grass and the site has significant amounts of blue grama, tall dropseed, red threeawn, and sideoats grama.

Loamy Terrace range site. The soils in this range site are on nearly level stream terraces and are subject to rare flooding. The potential native vegetation is mixed prairie grasses. Typically, the dominant grasses are big bluestem, which makes up about 40 percent of the vegetation; little bluestem, 15 percent; indiangrass, 15 percent; switchgrass, 10 percent; sideoats grama, 10 percent; and western wheatgrass, 5 percent. Other grasses are Canada wildrye, blue grama, sand dropseed, and tall dropseed. Forbs, such as American licorice, aromatic aster, catclaw sensitivebrier, heath aster, Illinois bundleflower, Louisiana sagewort, pitcher sage, slimflower scurfpea, and western ragweed, make up about 5 percent of the vegetation. Small amounts of American plum, pricklypear, and buckbrush are common.

This site is generally grazed along with larger areas of upland range sites. Because of the combination of sites, carefully applied management measures, such as properly located fences, water, salt, minerals, and feeding areas, are needed to achieve an adequate distribution of grazing. After periods of continued excessive use, the amount of big bluestem, little bluestem, and switchgrass decreases. Long-term overgrazing may remove these species from the site. Western wheatgrass and sideoats grama are the major increasers. Other increasers are forbs, blue grama, and tall dropseed. Returning a continuously overgrazed area to its original productivity is difficult. In areas where remnant stands of the taller grasses are evident, proper stocking rates and periodic deferment of grazing or a planned grazing system can help to return the site to near its potential. These measures also improve or maintain the site at any stage of productivity.

Loamy Upland range site. The potential native vegetation on this range site is mixed prairie grasses. Typically, the dominant grasses are big bluestem, which makes up about 35 percent of the vegetation; little bluestem, 20 percent; indiangrass, 15 percent; switchgrass, 10 percent; and sideoats grama, 10 percent. Other grasses are western wheatgrass, tall dropseed, Canada wildrye, blue grama, and Scribner panicum. Forbs, such as western ragweed, Louisiana sagewort, slimflower scurfpea, dotted gayfeather, daisy fleabane, heath aster, and scarlet globemallow, make up about 10 percent of the vegetation. Leadplant is common on this site but generally in small amounts.

Overgrazing on this site generally initially reduces the abundance of big bluestem, indiangrass, and switchgrass. Under these conditions, little bluestem, sideoats grama, and blue grama become the dominant vegetation. After periods of continued overgrazing, blue grama, sideoats grama, and western wheatgrass become the dominant species.

Once most of the taller species are removed from the site through grazing pressure and dry weather cycles, returning the site to its potential native vegetation is extremely difficult and may take several decades. Where remnant stands of the taller species are evident, the site can be returned to its production potential by proper stocking rates and a grazing system that includes a scheduled deferment of grazing during the growing season.

Saline Lowland range site. The soils in this range site are on stream terraces and are subject to rare flooding. The potential native vegetation is mixed prairie grasses that are salt tolerant. Typically, the dominant grasses are prairie cordgrass, which makes up about 35 percent of the vegetation; switchgrass, 15 percent; indiangrass, 15 percent; inland saltgrass, 10 percent; and western wheatgrass, 10 percent. Other grasses are alkali sacaton, buffalograss, and tall dropseed. Sedges and forbs, such as Maximilian sunflower, Pennsylvania smartweed, and western ragweed, make up about 15 percent of the vegetation.

Overgrazing on this site results in a rapid increase in the abundance of inland saltgrass and western wheatgrass. Most other grasses, except for alkali sacaton, decrease in abundance. Excessive use can almost create a monoculture of inland saltgrass.

Proper stocking rates and a planned grazing system generally can maintain this site near its potential or can improve areas where the range condition has

deteriorated. Recovery generally is slower, however, on this site than on the nonsaline sites. Grazing early in the growing season is important because the species that are tolerant of saline-alkali conditions tend to mature rapidly and become much less palatable late in the season. Periodic deferment of grazing helps to maintain the productivity and vigor of the preferred grass species. Controlled burning can result in better utilization of inland saltgrass for a short period.

Sandy range site. The soils in this range site are on uplands. The potential native vegetation is mixed prairie grasses. Typically, the dominant grasses are sand bluestem, which makes up about 40 percent of the vegetation; little bluestem, 20 percent; switchgrass, 10 percent; indiangrass, 10 percent; porcupinegrass, 5 percent; sideoats grama, 5 percent; and blue grama, 5 percent. Other grasses are sand lovegrass, sand dropseed, tall dropseed, hairy grama, windmillgrass, sand paspalum, and Scribner panicum. Forbs, such as Louisiana sagewort, poppymallow, slimflower scurfpea, upright prairie coneflower, western ragweed, and yarrow, make up about 5 percent of the vegetation. Chickasaw plum, sand sagebrush, and American plum make up about 5 percent.

This site generally is a highly preferred grazing area. Because of past grazing management, it generally has deteriorated more than most of the adjacent sites. Overgrazing rapidly reduces the abundance of big bluestem and sand bluestem. Sand bluestem is generally replaced by little bluestem, sideoats grama, blue grama, and sand dropseed. If overgrazing continues, the amount of little bluestem and switchgrass is reduced. After long periods of severe overgrazing, the site is dominated by sand dropseed, sand paspalum, annual grasses, unpalatable forbs, and woody species.

Management that includes proper grazing use and a scheduled deferment of grazing during the growing season maintains this site in a productive condition. Also, it can restore overgrazed areas to their original production potential if remnants of the original species are evident. Reseeding may be needed in areas where the more desirable mid and tall grasses have been removed.

Sandy Lowland range site. The soils in this range site are on flood plains adjacent to stream channels and are occasionally flooded. The potential native vegetation is tall prairie grasses. Typically, the dominant grasses are sand bluestem, which makes up about 30 percent of the vegetation; little bluestem, 15 percent; indiangrass, 15 percent; switchgrass, 10 percent; eastern gamagrass, 5 percent; and porcupinegrass, 5 percent. Other grasses are big sandreed, Canada wildrye, sand lovegrass, sideoats grama, western wheatgrass, blue grama, sand dropseed, perennial threeawn, and tall dropseed. Forbs, such as catclaw sensitivebrier, wooly verbena, Illinois bundleflower, Maximilian sunflower, Louisiana sagewort, and western ragweed, make up about 15 percent of the vegetation. Chickasaw plum, cottonwood, sandbar willow, and American plum make up about 5 percent.

Overgrazing on this site initially reduces the abundance of sand bluestem, indiangrass, switchgrass, and eastern gamagrass. As the production of these species decreases, the amount of western wheatgrass increases. To a small extent, the amount of threeawn and dropseed also increases. If overgrazing continues, kochia, Russian-thistle, and other undesirable annuals invade the site.

Once most of the taller species are removed from the site through grazing pressure and dry weather cycles, restoring the potential native vegetation is difficult. Where remnants of the taller species are evident, management that includes proper stocking rates and a scheduled deferment of grazing during the growing season is effective in restoring the site to near its potential.

Shallow Sandstone range site. The soils in this range site are on uplands. The potential native vegetation is mixed prairie grasses. Typically, the dominant grasses are little bluestem, which makes up about 35 percent of the vegetation; big bluestem, 30 percent; indiangrass, 10 percent; sideoats grama, 5 percent; and switchgrass, 5 percent. Other grasses are blue grama, sand dropseed, tall dropseed, buffalograss, western wheatgrass, and Scribner panicum. Forbs, such as dotted gayfeather, heath aster, slimflower scurfpea, Louisiana sagewort, and western ragweed, make up about 15 percent of the vegetation. Aromatic sumac, smooth sumac, and pricklypear are common but occur in small amounts.

In most areas overgrazing on this site initially reduces the abundance of big bluestem. Under these conditions, little bluestem and sideoats grama become the dominant vegetation. After periods of continued overgrazing, blue grama, hairy grama, sand dropseed, and buffalograss become the dominant species. Grazing pressure is rarely heavy enough to eliminate the preferred grasses from the site. Grazing management that includes proper stocking rates and periodic deferment of grazing during the growing season helps to maintain the site or restores it to its productive potential.

Native Woodland, Windbreaks, and Environmental Plantings

Keith A. Ticknor, forester, Soil Conservation Service, helped prepare this section.

The native woodland in Saline County is along the major streams and rivers and in upland drainageways. Only 3,400 acres in the county, or less than 1 percent of the land area, is woodland. The wooded strips are narrow. Because the wooded acreage is small and scattered, it is limited as a commercial resource.

The Detroit-Hord-Sutphen association, which is described under the heading "General Soil Map Units, includes the woodland along the rivers and their major tributaries. Wooded upland drainageways are in areas of all the associations. In areas of the Lancaster-Hedville-Crete association, however, only the lower reaches of the drainageways are wooded. The woodland in the county occurs as the hackberry-American elm-green ash forest cover type. The species composition varies from one area to another. No one species dominates the stands. Associated species include eastern cottonwood, black walnut, mulberry, black willow, peachleaf willow, sandbar willow, honeylocust, Osageorange, bur oak, boxelder, American plum, common chokecherry, roughleaf dogwood, indigobush, smooth sumac, indiancurrant coralberry (buckbrush), and vines, such as bristly greenbrier and riverbank grape.

The soils on bottom land and in upland drainageways have good potential for the production of timber for veneer, sawtimber, firewood, and other wood products. These soils are generally used as cropland, however, and are unlikely to be used for the production of wood products. Black walnut, which was heavily harvested in the past, is again well distributed in the woodland. If well managed, it can again become a valuable resource.

Windbreaks and environmental plantings are on most of the farmsteads and ranch headquarters in the county and around many rural residences near Salina. Siberian elm and eastern redcedar are the dominant species in the older farmstead plantings. A greater variety of species is generally planted around rural residences, but eastern redcedar is the chief species in most windbreaks. Other trees and shrubs are Austrian pine, Scotch pine, ponderosa pine, green ash, honeylocust, Russian olive, American elm, bur oak, northern catalpa, Osageorange, and lilac.

Additional trees and shrubs are continually needed around rural residences and on farms and ranches because old trees pass maturity and deteriorate and some trees are destroyed by insects, disease, or storms. Supplemental planting is needed to maintain the effectiveness of old windbreaks, in which Siberian elm is the dominant species.

Field windbreaks are numerous throughout the county. They generally occur as hedgerows and shelterbelts. Single hedgerows of Osageorange are abundant, even though many of them have been removed as fields have been enlarged and fences replaced. They were planted as property lines and field boundaries, as living fences, and as a source of posts. The Osageorange in these hedgerows readily invades poorly managed pastures.

Shelterbelts consisting of 8 to 10 rows of trees and shrubs were planted as part of the Prairie States Forestry Project between 1935 and 1942. Although few of these shelterbelts remain, they are a prominent feature of the landscape. They include numerous species, such as eastern redcedar, Siberian elm, honeylocust, hackberry, green ash, bur oak, Russian olive, Osageorange, ponderosa pine, American plum, black locust, tamarisk, mulberry, eastern cottonwood, American elm, Kentucky coffeetree, black walnut, and apricot.

In order for windbreaks and environmental plantings to fulfill their intended purpose, the soils on the site should be suited to the trees and shrubs selected for planting. Permeability, available water capacity, fertility, depth, and texture greatly affect the growth rate.

Establishing trees and shrubs is somewhat difficult in Saline County because the amount of moisture usually is limited during the growing season. Hot, drying winds also are common. The main management needs are proper site preparation prior to planting and control of weeds and other competing plants after planting. Cover crops may be needed to protect new plants from hot winds and windblown soil particles. Supplemental watering is necessary during dry periods.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees anc

shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

Robert J. Higgins, biologist, Soil Conservation Service, helped prepare this section.

Saline County has several areas of scenic, geologic, and historic interest. Farm ponds and the Smoky Hill and Saline Rivers provide opportunities for water sports. The Saline State Fishing Lake is open to the public. Several private recreational areas have been developed in the county. Areas of historic interest include Coronado Heights and the Brookville Hotel. The county is diverse geologically. It includes nearly level bottom land dissected by wooded streams and rough sandstone hills and bluffs covered by native bluestem. The potential for additional recreational development within the county is fair.

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to drinking water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation also are important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

Robert J. Higgins, biologist, Soil Conservation Service, helped prepare this section.

The primary game species in Saline County are ring-necked pheasant, bobwhite quail, prairie chicken, cottontail rabbit, white-tailed deer, and several species of waterfowl. Nongame species are numerous because of the diversity of habitat types. Cropland, woodland, and grassland are intermixed throughout the county, creating the desirable "edge" effect needed for a variety of wildlife species. Each of these habitat types provides habitat for a particular group of species.

Furbearers are sparse to common along the Smoky Hill and Saline Rivers and their tributaries. They are trapped on a limited basis.

The Saline State Fishing Lake and many farm ponds and streams provide good to excellent fishing. The species commonly caught are largemouth bass, bluegill, carp, channel cat, bullhead, and flathead catfish.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture also are considerations. Examples of grain and seed crops are wheat, sorghum, soybeans, corn, and oats.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture also are considerations. Examples of grasses and legumes are fescue, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture also are considerations. Examples of wild herbaceous plants are bluestems, switchgrass, indiangrass, gramas, wheatgrass, goldenrod, ragweed, sunflowers, and native legumes.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwoods and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, hackberry, black walnut, cottonwood, elm, mulberry, ash, and willow. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian olive, autumn olive, plum, fragrant sumac, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are eastern redcedar, pine, spruce, and juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of native shrubs are plum, wild currant, dogwood, buckbrush, prairie rose, and sumac.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, cattails, indigobush, prairie cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface

stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include bobwhite quail, pheasant, mourning dove, meadowlark, field sparrow, and cottontail rabbit.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include owls, hawks, wild turkey, thrushes, woodpeckers, squirrels, opossum, raccoon, and white-tailed deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, redwing blackbirds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include jackrabbits, hawks, badgers, killdeer, prairie chicken, meadowlark, and lark bunting.

Technical assistance in planning wildlife areas and in determining the vegetation suitable for planting can be obtained from the local office of the Soil Conservation Service. Additional information and assistance can be obtained from the Kansas Department of Wildlife and Parks and from the Cooperative Extension Service.

Engineering

John Eberwein, civil engineer, Soil Conservation Service, helped prepare this section.

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, the shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreation uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial

buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, the shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. The depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), the shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Sanitary Facilities

Table 12 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the

solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and the shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable

material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and depth to the water table is less than 1 foot. These soils may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is as much as 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment

can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to help to control water erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

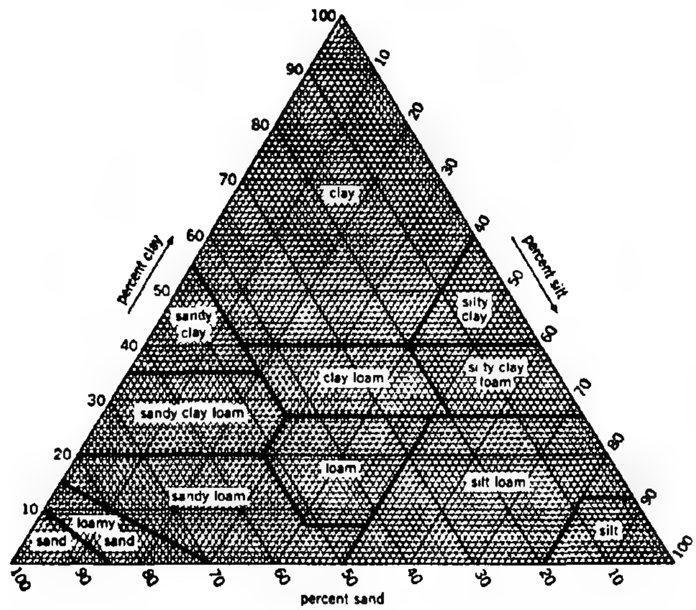

Figure 16.—Percentages of sand, silt, and clay in the basic USDA soil textural classes.

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 16). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to

those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated content of clay in each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓ bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at

saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

8. Soils that are not subject to soil blowing because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning

that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table, the kind of water table, and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17. Only saturated zones within a depth of about 6 feet are indicated. An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion

of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion also is expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(8)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustoll (*Ust*, meaning intermittent dryness, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Argiustolls (*Argi*, meaning argillic horizon, plus *ustoll*, the suborder of the Mollisols that has an ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Pachic* identifies the subgroup that has a thicker surface layer than is typical for the great group. An example is Pachic Argiustolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine, montmorillonitic, mesic Pachic Argiustolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual (7)*. Many of the technical terms used in the descriptions are defined in *Soil Taxonomy (8)*. Unless otherwise stated, matrix colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Bavaria Series

The Bavaria series consists of deep, moderately well drained, slowly permeable soils on stream terraces.

These soils formed in calcareous, silty alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Bavaria silt loam, in an area of Bavaria-Detroit complex, 1,980 feet north and 560 feet west of the southeast corner of sec. 7, T. 14 S., R. 3 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable; few very fine roots; sodium adsorption ratio of 16; neutral; clear smooth boundary.

An—6 to 13 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; moderate fine granular structure; very hard, very firm; sodium adsorption ratio of 16; electrical conductivity of 3.5 millimhos per centimeter; few fine roots; neutral; clear wavy boundary.

Btny—13 to 21 inches; dark grayish brown (10YR 4/2) silty clay, very dark brown (10YR 2/2) moist; weak medium columnar structure parting to moderate fine subangular blocky; extremely hard, very firm; few faint discontinuous clay films on faces of peds; few medium irregular gypsum crystals; common medium accumulations of salt crystals; sodium adsorption ratio of 17; electrical conductivity of 9.4 millimhos per centimeter; few very fine roots between peds; very slight effervescence; moderately alkaline; clear wavy boundary.

Btn—21 to 35 inches; grayish brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; extremely hard, very firm; few faint discontinuous clay films on faces of peds; sodium adsorption ratio of 23; electrical conductivity of 2.0 millimhos per centimeter; few very fine roots; slight effervescence; moderately alkaline; gradual smooth boundary.

Bkn—35 to 45 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; few fine prominent reddish brown (5YR 4/4) mottles; weak medium subangular blocky structure; very hard, very firm; few medium irregular concretions of calcium carbonate; slight effervescence; moderately alkaline; gradual smooth boundary.

Cy—45 to 60 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; few fine prominent reddish brown (5YR 4/4) mottles; massive; hard, firm; few medium irregular gypsum crystals; slight effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 20 to 40 inches. The depth to calcium carbonates ranges from 10 to 30 inches.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It typically is silt loam, but the range includes silty clay loam. Reaction is slightly acid or neutral. The sodium adsorption ratio ranges from 8 to 18, and the electrical conductivity ranges from 2 to 4 millimhos per centimeter.

The Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6 (2 to 4 moist), and chroma of 2 or 3. It is silty clay or silty clay loam. Reaction ranges from mildly alkaline to strongly alkaline. The sodium adsorption ratio ranges from 15 to 25, and the electrical conductivity ranges from 2 to 10 millimhos per centimeter.

The Bk and Cy horizons have hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. Reaction ranges from mildly alkaline to strongly alkaline.

Cass Series

The Cass series consists of deep, well drained, moderately rapidly permeable soils on flood plains. These soils formed in noncalcareous, stratified, loamy and sandy alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Cass fine sandy loam, occasionally flooded, 1,800 feet west and 1,050 feet north of the southeast corner of sec. 4, T. 15 S., R. 5 W.

Ap—0 to 7 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; neutral; clear smooth boundary.

A—7 to 13 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; neutral; gradual smooth boundary.

AC—13 to 24 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak fine granular structure; slightly hard, friable; neutral; gradual smooth boundary.

C—24 to 60 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable; neutral.

The thickness of the mollic epipedon ranges from 10 to 20 inches. The depth to free carbonates is more than 40 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It typically is fine sandy loam but is loam in some pedons. It ranges from medium acid to neutral.

The C horizon has value of 5 to 7 (4 or 5 moist) and chroma of 2 or 3. It typically is fine sandy loam throughout but in some pedons is loamy fine sand in the lower part. Strata of more sandy or more loamy material are common. This horizon is neutral or mildly alkaline.

Clime Series

The Clime series consists of moderately deep, well drained, slowly permeable soils on uplands. These soils formed in material weathered from calcareous, clayey shale. Slopes range from 2 to 20 percent.

Typical pedon of Clime silty clay loam, 2 to 6 percent slopes, 600 feet north and 200 feet east of the southwest corner of sec. 1, T. 14 S., R. 1 W.

Ap—0 to 8 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; hard, firm; many fine roots; strong effervescence; moderately alkaline; abrupt smooth boundary.

Bw—8 to 20 inches; yellowish brown (10YR 5/4) silty clay, dark yellowish brown (10YR 4/4) moist; moderate fine subangular blocky structure; very hard, very firm; few fine roots; common threads and films of lime; strong effervescence; moderately alkaline; clear smooth boundary.

C—20 to 28 inches; yellowish brown (10YR 5/4) silty clay, dark yellowish brown (10YR 4/4) moist; massive; very hard, very firm; common fine fragments of shale and sandstone; common threads and films of lime; strong effervescence; moderately alkaline; clear smooth boundary.

Cr—28 inches; light gray (10YR 7/2), partially weathered, calcareous, clayey shale.

The depth to shale ranges from 20 to 40 inches. Lime is generally disseminated throughout the soil mass. In some pedons, however, the upper 10 inches contains no lime. The mollic epipedon ranges from 7 to 20 inches in thickness. Flaggy limestone fragments cover 0 to 15 percent of the surface. Reaction is mildly alkaline or moderately alkaline throughout the profile.

The A horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It typically is silty clay loam, but the range includes silty clay and flaggy silty clay loam. The Bw horizon has hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 1 to 4. It is clay, silty clay, or silty clay loam. The C horizon has hue of 10YR, 2.5Y, or 5Y; value of 5 to 7 (4 to 6 moist); and chroma of 2 to 4. It is silty clay or clay. The content of shale fragments in this horizon is less than 35 percent.

Cozad Series

The Cozad series consists of deep, well drained, moderately permeable soils on terraces. These soils formed in silty and loamy alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Cozad silt loam, 1,300 feet west and 50 feet north of the southeast corner of sec. 1, T. 13 S., R. 2 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable; few fine roots; neutral; clear smooth boundary.

A—6 to 14 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; neutral; gradual smooth boundary.

AC—14 to 20 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; slightly hard, friable; neutral; gradual smooth boundary.

C1—20 to 36 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; soft, very friable; neutral; gradual smooth boundary.

C2—36 to 60 inches; pale brown (10YR 6/3) very fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable; slight effervescence; mildly alkaline.

The mollic epipedon ranges from 10 to 20 inches in thickness. The depth to lime ranges from 10 to 48 inches.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It typically is silt loam, but the range includes loam and very fine sandy loam. This horizon is slightly acid or neutral. The C horizon has value of 5 to 7 (4 or 5 moist) and chroma of 2 or 3. It is silt loam or very fine sandy loam. In some pedons it has thin strata of varying textures. It ranges from neutral to moderately alkaline.

Crete Series

The Crete series consists of deep, moderately well drained soils on uplands. These soils formed in loess. Permeability is slow in the subsoil and moderate or moderately slow in the substratum. Slopes range from 0 to 7 percent.

Typical pedon of Crete silt loam, 0 to 2 percent slopes, 1,320 feet north and 75 feet east of the southwest corner of sec. 1, T. 13 S., R. 1 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; hard, friable; few fine roots; medium acid; abrupt smooth boundary.

A—6 to 10 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; hard, friable; few fine roots; medium acid; clear smooth boundary.

BA—10 to 16 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2)

moist; weak medium subangular blocky structure; hard, firm; few fine roots; slightly acid; clear smooth boundary.

Bt1—16 to 32 inches; brown (10YR 5/3) silty clay, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium blocky; very hard, very firm; common distinct clay films on faces of peds; neutral; gradual smooth boundary.

Bt2—32 to 44 inches; pale brown (10YR 6/3) silty clay, grayish brown (10YR 5/2) moist; moderate medium prismatic structure parting to moderate medium blocky; very hard, very firm; common distinct clay films on faces of peds and in root channels; mildly alkaline; clear smooth boundary.

BC—44 to 50 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, firm; few fine concretions of carbonate; few distinct dark coatings on faces of peds; slight effervescence; moderately alkaline; gradual smooth boundary.

C—50 to 60 inches; light yellowish brown (10YR 6/4) silt loam, yellowish brown (10YR 5/4) moist; massive; hard, friable; slight effervescence; moderately alkaline.

The depth to free carbonates ranges from 25 to 50 inches. The thickness of the mollic epipedon ranges from 20 to 36 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It typically is silt loam, but in some pedons it is silty clay loam. The Bt horizon has value of 4 to 6 (3 to 5 moist) and chroma of 2 or 3. It is silty clay or silty clay loam. It is neutral or mildly alkaline. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6 (4 or 5 moist), and chroma of 2 to 4. It is silt loam or silty clay loam. It is mildly alkaline or moderately alkaline.

Detroit Series

The Detroit series consists of deep, moderately well drained, slowly permeable soils on terraces. These soils formed in silty alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Detroit silty clay loam, 100 feet east and 160 feet south of the northwest corner of sec. 5, T. 14 S., R. 2 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silty clay loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable; few very fine roots; neutral; clear smooth boundary.

AB—7 to 14 inches; very dark grayish brown (10YR 3/2) silty clay loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure; hard, friable; few very fine roots; neutral; clear wavy boundary.

Bt1—14 to 23 inches; very dark grayish brown (10YR 3/2) silty clay, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; hard, firm; few very fine roots; common distinct clay films on faces of peds; neutral; clear wavy boundary.

Bt2—23 to 32 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, firm; few very fine roots; common distinct clay films on faces of peds and in root channels; neutral; clear wavy boundary.

Bt3—32 to 38 inches; brown (10YR 4/3) silty clay, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, firm; few very fine roots; neutral; clear wavy boundary.

BC—38 to 46 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; common fine prominent strong brown (7.5YR 5/6) mottles; weak coarse subangular blocky structure; hard, friable; common fine accumulations of very dark brown oxide; few fine accumulations of carbonate below a depth of 40 inches; slight effervescence; mildly alkaline; gradual smooth boundary.

C1—46 to 53 inches; light yellowish brown (10YR 6/4) silt loam, brown (10YR 5/3) moist; common medium distinct yellowish brown (10YR 5/6) mottles; massive; slightly hard, very friable; few fine accumulations of very dark brown oxide; few fine accumulations of carbonate; strong effervescence; moderately alkaline; clear smooth boundary.

C2—53 to 60 inches; light brownish gray (10YR 6/2) silty clay loam, grayish brown (10YR 5/2) moist; common medium prominent yellowish brown (10YR 5/6) mottles; massive; slightly hard, friable; a few strata of grayish brown (10YR 5/2) material; common fine concretions of carbonate; violent effervescence; moderately alkaline.

The depth to lime ranges from 22 to 50 inches. The mollic epipedon is 20 to 40 inches thick.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It is silt loam or silty clay loam. It is slightly acid or neutral. The Bt horizon has value of 3 to 5 (2 or 3 moist) and chroma of 2 or 3. It is silty clay loam or silty clay. It is neutral or mildly alkaline. The C horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 4 to 6 (3 to 5 moist); and chroma of 2 to 4. It is silt loam or silty clay loam.

Edalgo Series

The Edalgo series consists of moderately deep, well drained, very slowly permeable soils on uplands. These soils formed in material weathered from noncalcareous shale. Slopes range from 3 to 7 percent.

Typical pedon of Edalgo clay loam, 3 to 7 percent slopes, 1,000 feet east and 300 feet north of the southwest corner of sec. 5, T. 14 S., R. 5 W.

A—0 to 9 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; hard, friable; common fine roots; medium acid; gradual smooth boundary.

Bt1—9 to 13 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate fine subangular blocky structure; very hard, very firm; common fine roots; common distinct clay films on faces of peds; few fine sandstone fragments; slightly acid; gradual smooth boundary.

2Bt2—13 to 21 inches; light brown (7.5YR 6/4) silty clay, brown (7.5YR 5/4) moist; moderate medium subangular blocky structure; very hard, very firm; few fine roots; common distinct clay films on faces of peds; few fine accumulations of carbonate; neutral; clear wavy boundary.

2C—21 to 28 inches; brownish yellow (10YR 6/8) and light gray (10YR 7/1) silty clay, yellowish brown (10YR 5/6) and gray (10YR 5/1) moist; massive; very hard, very firm; few fine roots; few fine accumulations of carbonate; neutral; clear wavy boundary.

2Cr—28 inches; light gray (10YR 7/1) shale.

The depth to shale bedrock is 20 to 40 inches. The mollic epipedon is 8 to 18 inches thick. The solum has no lime, but in most pedons the C horizon has threads and concretions of lime. The solum ranges from medium acid to neutral.

The A horizon has hue of 7.5YR or 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It typically is clay loam, but the range includes silt loam, loam, and silty clay loam. The Bt and 2Bt horizons have hue of 7.5YR to 2.5Y, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. They are silty clay, silty clay loam, or clay loam. The 2C horizon has hue of 5YR to 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 1 to 8. It is clay or silty clay. It is neutral to moderately alkaline.

Geary Series

The Geary series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in reddish brown loess. Slopes range from 1 to 7 percent.

Typical pedon of Geary silt loam, 1 to 3 percent slopes, 70 feet south and 240 feet west of the center of sec. 9, T. 14 S., R. 1 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; hard, friable; few fine roots; medium acid; abrupt smooth boundary.

BA—9 to 15 inches; brown (7.5YR 4/2) silty clay loam, dark brown (7.5YR 3/2) moist; moderate fine subangular blocky structure; very hard, firm; few fine roots; medium acid; gradual smooth boundary.

Bt1—15 to 23 inches; brown (7.5YR 4/4) silty clay loam, dark brown (7.5YR 3/4) moist; moderate fine subangular blocky structure; very hard, firm; few faint clay films on some horizontal and vertical faces of peds; slightly acid; gradual smooth boundary.

Bt2—23 to 32 inches; brown (7.5YR 4/4) silty clay loam, dark brown (7.5YR 3/4) moist; moderate medium subangular blocky structure; very hard, firm; few faint clay films on faces of some peds; slightly acid; gradual smooth boundary.

BC—32 to 42 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; weak coarse subangular blocky structure; very hard, friable; neutral; gradual smooth boundary.

C—42 to 60 inches; reddish brown (5YR 5/3) silty clay loam, reddish brown (5YR 4/3) moist; massive; hard, friable; porous; mildly alkaline.

The thickness of the mollic epipedon ranges from 10 to 20 inches. The depth to free carbonates ranges from 36 to more than 60 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2. It typically is silt loam, but it is silty clay loam in some pedons. It is slightly acid or medium acid. The Bt horizon has hue of 7.5YR or 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 to 5. It is silty clay loam or clay loam. It is slightly acid or neutral. The C horizon has hue of 7.5YR or 5YR, value of 5 to 7 (4 or 5 moist), and chroma of 4 to 6. It is clay loam or silty clay loam. It ranges from neutral to moderately alkaline.

Hedville Series

The Hedville series consists of shallow, somewhat excessively drained, moderately permeable soils on uplands. These soils formed in material weathered from noncalcareous sandstone. Slopes range from 3 to 20 percent.

Typical pedon of Hedville loam, in an area of Lancaster-Hedville complex, 3 to 20 percent slopes, 2,600 feet west and 1,300 feet north of the southeast corner of sec. 17, T. 15 S., R. 4 W.

A—0 to 8 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; many fine roots; about 15 percent angular sandstone fragments, mainly ½ inch to 3 inches in size; medium acid; clear smooth boundary.

Bw—8 to 17 inches; reddish brown (5YR 5/4) gravelly loam, reddish brown (5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, friable; many fine roots; about 30 percent angular sandstone fragments, mainly ½ inch to 3 inches in size; medium acid; clear irregular boundary.

R—17 inches; brown sandstone.

The depth to sandstone ranges from 4 to 20 inches. Reaction ranges from medium acid to neutral throughout the profile.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 to 3. It typically is loam, but the range includes cobbly loam, fine sandy loam, and sandy loam. The content of rock fragments in this horizon is less than 35 percent. The Bw horizon has hue of 10YR, 7.5YR, or 5YR; value of 5 or 6 (4 or 5 moist); and chroma of 2 to 4. It typically is gravelly loam, but the range includes loam, fine sandy loam, and sandy loam. Some pedons do not have a Bw horizon.

Hord Series

The Hord series consists of deep, well drained, moderately permeable soils on stream terraces. These soils formed in silty alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Hord silt loam, 350 feet east and 650 feet south of the northwest corner of sec. 5, T. 14 S., R. 1 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak medium granular structure; slightly hard, friable; few worm casts; common fine roots; slightly acid; abrupt smooth boundary.

A—7 to 15 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; slightly hard, friable; few worm casts; few fine roots; slightly acid; clear smooth boundary.

Bw—15 to 22 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable; neutral; clear smooth boundary.

BC—22 to 31 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak fine subangular blocky; slightly hard, friable; mildly alkaline; clear smooth boundary.

C—31 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; massive; slightly hard, friable; few fine threads of calcium carbonate; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 20 to 40 inches. The depth to lime ranges from 24 to 48 inches. The texture is silt loam or silty clay loam throughout the profile.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is medium acid to neutral. The Bw horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. The C horizon has hue of 10YR, value of 4 to 7 (3 to 5 moist), and chroma of 2 or 3. It is mildly alkaline or moderately alkaline.

Irwin Series

The Irwin series consists of deep, moderately well drained, very slowly permeable soils on broad ridgetops and side slopes in the uplands. These soils formed in clayey sediments. Slopes range from 1 to 7 percent.

Typical pedon of Irwin silty clay loam, 1 to 3 percent slopes, 250 feet west and 1,450 feet north of the southeast corner of sec. 36, T. 15 S., R. 1 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; weak medium granular structure; hard, friable; few fine roots; slightly acid; abrupt smooth boundary.

A—6 to 11 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; hard, firm; few fine roots; slightly acid; clear smooth boundary.

Bt1—11 to 24 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium blocky structure; very hard, very firm; few fine roots; common distinct clay films on faces of peds; slightly acid; gradual smooth boundary.

Bt2—24 to 34 inches; brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; moderate medium blocky structure; very hard, very firm; few distinct clay films on faces of peds; few fine soft calcareous masses; mildly alkaline; gradual smooth boundary.

BC—34 to 43 inches; brown (10YR 5/3) silty clay, dark brown (10YR 4/3) moist; weak medium blocky

structure; very hard, very firm; few soft calcareous masses; slight effervescence; mildly alkaline; gradual smooth boundary.

C—43 to 60 inches; brown (10YR 5/3) silty clay, dark brown (10YR 4/3) moist; massive; very hard, very firm; common coarse prominent strong brown (7.5YR 5/6) mottles; weakly calcareous in spots; mildly alkaline.

The mollic epipedon is 20 to 40 inches thick. The depth to silty clay or clay is less than 14 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It typically is silty clay loam but in some pedons is silt loam. It ranges from medium acid to neutral. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5 (3 or 4 moist), and chroma of 2 or 3. It is silty clay or clay. It ranges from medium acid to neutral in the upper part and is neutral or mildly alkaline in the lower part. The C horizon has hue of 2.5Y to 7.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. It is silty clay or clay. It is mildly alkaline or moderately alkaline.

Kipson Series

The Kipson series consists of shallow, somewhat excessively drained, moderately permeable soils on uplands. These soils formed in material weathered from calcareous, silty shale. Slopes range from 6 to 20 percent.

Typical pedon of Kipson silt loam, in an area of Kipson-Clime complex, 6 to 20 percent slopes, 2,300 feet north and 300 feet west of the southeast corner of sec. 12, T. 15 S., R. 1 W.

A—0 to 7 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; moderate medium granular structure; slightly hard, friable; many fine roots; slight effervescence; mildly alkaline; clear smooth boundary.

AC—7 to 13 inches; light brownish gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak medium granular structure; slightly hard, friable; common fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

C—13 to 18 inches; light gray (10YR 7/2) silty clay loam, light brownish gray (10YR 6/2) moist; massive; slightly hard, friable; few fine roots; common fragments of shale and limestone; strong effervescence; moderately alkaline; clear smooth boundary.

Cr—18 inches; light gray (10YR 7/2) shale and chalky limestone.

The mollic epipedon is 6 to 12 inches thick. The depth to bedrock ranges from 7 to 20 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It typically is silt loam, but in some pedons it is silty clay loam. It is neutral to moderately alkaline. The C horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is moderately alkaline or strongly alkaline.

Lancaster Series

The Lancaster series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in material weathered from noncalcareous sandstone and sandy shale. Slopes range from 3 to 12 percent.

Typical pedon of Lancaster loam, 3 to 7 percent slopes, 175 feet north and 45 feet west of the southeast corner of sec. 17, T. 14 S., R. 4 W.

A—0 to 9 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak medium granular structure; hard, friable; few fine roots; medium acid; gradual smooth boundary.

BA—9 to 16 inches; brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate fine subangular blocky structure; hard, friable; few fine roots; less than 5 percent hard sandstone fragments; medium acid; gradual smooth boundary.

Bt—16 to 24 inches; brown (7.5YR 5/4) clay loam, brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; very hard, firm; few fine roots; slightly darker clay films on faces of peds and in root channels; slightly acid; gradual smooth boundary.

BC—24 to 30 inches; reddish yellow (7.5YR 6/6) sandy clay loam, strong brown (7.5YR 5/6) moist; streaked and splotched with colors that are more yellow and more gray than the soil mass and with few distinct reddish spots; weak medium blocky structure; very hard, firm; few fine roots; darker clay films on faces of some peds; neutral; gradual smooth boundary.

Cr—30 inches; partially weathered, sandy shale.

The depth to bedrock ranges from 20 to 40 inches. The mollic epipedon ranges from 8 to 20 inches in thickness. Most pedons have fragments of sandstone in one or more horizons.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It typically is loam, but in some pedons it is fine sandy loam. It is medium acid or slightly acid. The Bt horizon has hue of 5YR, 7.5YR, or 10YR; value of 4 to 6 (3 to 5 moist); and chroma of 3 to 6. It is clay loam, sandy clay loam, or loam. It is medium acid to neutral.

Longford Series

The Longford series consists of deep, well drained, slowly permeable soils on uplands. These soils formed in loess. Slopes range from 1 to 7 percent.

Typical pedon of Longford silt loam, 1 to 3 percent slopes, 1,400 feet west and 75 feet south of the northeast corner of sec. 6, T. 16 S., R. 1 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable; many fine roots; slightly acid; abrupt smooth boundary.

A—6 to 11 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; strong fine granular structure; slightly hard, friable; few fine roots; slightly acid; gradual smooth boundary.

BA—11 to 17 inches; brown (10YR 4/3) silty clay loam, dark brown (10YR 3/3) moist; strong fine subangular blocky structure; hard, friable; slightly acid; gradual smooth boundary.

Bt1—17 to 25 inches; reddish brown (5YR 4/4) silty clay, dark reddish brown (5YR 3/4) moist; strong fine subangular blocky structure; hard, firm; common distinct clay films on faces of peds; slightly acid; gradual smooth boundary.

Bt2—25 to 38 inches; yellowish red (5YR 5/6) silty clay, yellowish red (5YR 4/6) moist; strong fine and medium subangular blocky structure; very hard, firm; common distinct clay films on faces of peds; few fine and medium black concretions; few fine sandstone pebbles; slightly acid; gradual smooth boundary.

BC—38 to 45 inches; reddish yellow (5YR 6/6) silty clay loam, yellowish red (5YR 5/6) moist; moderate medium subangular blocky structure; hard, friable; few faint clay films on faces of peds; neutral; gradual smooth boundary.

2C—45 to 60 inches; light reddish brown (5YR 6/4) clay loam, reddish brown (5YR 5/4) moist; massive; slightly hard, friable; neutral.

The mollic epipedon is 10 to 20 inches thick. The depth to lime ranges from 36 to more than 60 inches. In some pedons a few small pebbles are in the lower part of the Bt horizon or in the BC horizon.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It typically is silt loam, but the range includes silty clay loam. This horizon is medium acid to neutral. The Bt horizon has hue of 7.5YR or 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 6. It is silty clay or silty clay loam. It is slightly acid or neutral. The 2C horizon has hue of 5YR to 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 3 to 6. It is silty clay loam, clay loam, or silt loam. It is slightly acid to mildly alkaline.

McCook Series

The McCook series consists of deep, well drained, moderately permeable soils on stream terraces. These soils formed in calcareous alluvium. Slopes range from 0 to 2 percent.

Typical pedon of McCook silt loam, 800 feet north and 150 feet east of the southwest corner of sec. 35, T. 13 S., R. 1 W.

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable; slight effervescence; mildly alkaline; abrupt smooth boundary.

A—5 to 11 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; many fine pores; strong effervescence; moderately alkaline; clear smooth boundary.

AC—11 to 17 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak medium granular; slightly hard, friable; many fine pores; strong effervescence; moderately alkaline; gradual smooth boundary.

C1—17 to 30 inches; very pale brown (10YR 7/3) very fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable; few thin strata of silt loam; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—30 to 60 inches; light gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; massive; soft, very friable; few thin strata of very fine sandy loam; strong effervescence; moderately alkaline.

The thickness of mollic epipedon ranges from 10 to 20 inches. Most pedons are calcareous to the surface, but some do not have free carbonates in the upper 10 inches. Reaction is mildly alkaline or moderately alkaline throughout the profile.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It typically is silt loam, but the range includes loam and very fine sandy loam. The AC and C horizons have hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3. They are typically silt loam or very fine sandy loam, but the range includes loam. Also, thin strata of more sandy or more clayey material or buried soil layers are common in the C horizon, and coarse sand or gravelly sand is below a depth of 40 inches in some pedons.

Figure 17.—Profile of New Cambria silty clay, which formed in silty and clayey alluvium. Numerous cracks indicate a high shrink-swell potential. Depth is marked in feet.

New Cambria Series

The New Cambria series consists of deep, moderately well drained, slowly permeable soils on stream terraces. These soils formed in calcareous, silty and clayey alluvium (fig. 17). Slopes range from 0 to 2 percent.

Typical pedon of New Cambria silty clay, 100 feet east and 1,100 feet south of the northwest corner of sec. 35, T. 13 S., R. 1 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silty clay, very dark gray (10YR 3/1) moist; moderate fine granular structure; very hard, firm; few fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

A—6 to 14 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; strong fine granular structure; extremely hard, very firm; few fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

Bw1—14 to 28 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate fine blocky structure; extremely hard, very firm; strong effervescence; moderately alkaline; gradual smooth boundary.

Bw2—28 to 40 inches; grayish brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; extremely hard, very firm; strong effervescence; moderately alkaline; gradual smooth boundary.

C—40 to 60 inches; light brownish gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; extremely hard, firm; few scattered films and threads of lime; strong effervescence; moderately alkaline.

The mollic epipedon is 20 to 40 inches thick. The depth to lime typically is less than 10 inches but ranges from 0 to 15 inches. The soils commonly are moderately alkaline throughout, but the upper 15 inches may be mildly alkaline. The texture is silty clay or silty clay loam throughout the profile.

The A horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. The Bw horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 to 4 moist), and chroma of 1 or 2. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6 (4 or 5 moist), and chroma of 1 to 3.

Ortello Series

The Ortello series consists of deep, well drained soils on uplands and stream terraces. These soils formed in sandy eolian and alluvial deposits. Permeability is moderately rapid. Slopes range from 2 to 6 percent.

Typical pedon of Ortello fine sandy loam, 2 to 6 percent slopes, 400 feet west and 100 feet north of the southeast corner of sec. 4, T. 16 S., R. 1 W.

Ap—0 to 6 inches; brown (10YR 4/3) fine sandy loam,

dark brown (10YR 3/3) moist; weak fine granular structure; soft, very friable; neutral; abrupt smooth boundary.

A—6 to 14 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; moderate fine granular structure; soft, very friable; neutral; clear smooth boundary.

Bw—14 to 31 inches; brown (10YR 5/3) fine sandy loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, very friable; neutral; gradual smooth boundary.

C—31 to 60 inches; very pale brown (10YR 7/3) loamy fine sand, pale brown (10YR 6/3) moist; single grained; loose; mildly alkaline.

The mollic epipedon ranges from 8 to 20 inches in thickness. A few scattered pebbles are throughout the profile in some areas.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 to 3. It typically is fine sandy loam, but the range includes loam, very fine sandy loam, sandy loam, and loamy fine sand. Reaction is slightly acid or neutral.

The Bw horizon has hue of 10YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. It is fine sandy loam or sandy loam. Reaction is slightly acid or neutral.

The C horizon has hue of 10YR or 2.5Y, value of 6 to 8 (5 or 6 moist), and chroma of 2 to 4. It typically is loamy fine sand, but the range includes loamy sand, fine sandy loam, sandy loam, coarse sandy loam, fine sand, and loamy coarse sand. Reaction is neutral or mildly alkaline.

Roxbury Series

The Roxbury series consists of deep, well drained, moderately permeable soils on terraces. These soils formed in calcareous, silty alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Roxbury silt loam, 120 feet east and 1,900 feet north of the southwest corner of sec. 6, T. 14 S., R. 1 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, very friable; strong effervescence; mildly alkaline; abrupt smooth boundary.

A—7 to 26 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; strong effervescence; mildly alkaline; gradual smooth boundary.

C1—26 to 36 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak medium granular structure; hard, friable; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—36 to 60 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; massive; hard, friable; strong effervescence; moderately alkaline.

The mollic epipedon is more than 20 inches thick. The depth to lime is less than 15 inches. Reaction is mildly alkaline or moderately alkaline throughout the profile.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It typically is silt loam, but the range includes loam and silty clay loam. The C horizon has hue of 10YR, value of 5 to 7 (4 or 5 moist), and chroma of 2 or 3. It is dominantly silt loam, silty clay loam, or loam. In some pedons, however, it has thin strata of more clayey or more sandy material.

Smolan Series

The Smolan series consists of deep, well drained, slowly permeable soils on uplands. These soils formed in reddish brown loess. Slopes range from 0 to 2 percent.

Typical pedon of Smolan silt loam, 0 to 2 percent slopes, 1,100 feet north and 100 feet east of the southwest corner of sec. 33, T. 15 S., R. 1 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; medium acid; clear smooth boundary.

A—6 to 12 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate fine and very fine granular structure; slightly hard, friable; few fine roots; medium acid; clear smooth boundary.

BA—12 to 18 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; hard, firm; few fine roots; slightly acid; gradual smooth boundary.

Bt1—18 to 24 inches; grayish brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; very hard, very firm; common distinct clay films on faces of peds; slightly acid; gradual smooth boundary.

Bt2—24 to 30 inches; brown (7.5YR 5/4) silty clay, dark brown (7.5YR 4/3) moist; moderate medium blocky structure; very hard, firm; common distinct clay films on faces of peds; neutral; gradual smooth boundary.

BC—30 to 46 inches; reddish brown (5YR 5/3) silty clay loam, reddish brown (5YR 4/3) moist; weak medium and coarse subangular blocky structure; very hard, friable; common faint clay films on faces of peds; mildly alkaline; few small concretions and threads of carbonate; diffuse smooth boundary.

C—46 to 79 inches; reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) dry; massive; hard, friable; mildly alkaline.

The mollic epipedon is 20 to 30 inches thick. The depth to free carbonates ranges from 30 to more than 70 inches.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 to 3. It typically is silt loam, but in some pedons it is silty clay loam. It ranges from medium acid to neutral. The Bt horizon has hue of 10YR to 5YR, value of 4 or 5 (3 or 4 moist), and chroma of 2 to 4. It is silty clay or silty clay loam. It ranges from medium acid to mildly alkaline. The C horizon has hue of 7.5YR or 5YR, value of 5 or 6 (3 or 4 moist), and chroma of 3 to 6. It is neutral or mildly alkaline.

Solomon Series

The Solomon series consists of deep, poorly drained, very slowly permeable soils in depressions and old meander scars on flood plains. These soils formed in calcareous, clayey alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Solomon silty clay, occasionally flooded, 1,000 feet north and 100 feet east of the southwest corner of sec. 35, T. 13 S., R. 3 W.

Ap—0 to 4 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; strong fine granular structure; very hard, firm; many fine roots; strong effervescence; moderately alkaline; abrupt smooth boundary.

A—4 to 16 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate fine and medium blocky structure; extremely hard, very firm; shiny faces of peds; few fine concretions of calcium carbonate; strong effervescence; moderately alkaline; gradual smooth boundary.

Bg—16 to 32 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; weak medium and coarse blocky structure; extremely hard, very firm; pressure faces; shiny faces of peds; few fine concretions of calcium carbonate; strong effervescence; moderately alkaline; diffuse smooth boundary.

BCg—32 to 50 inches; very dark gray (10YR 3/1) and dark gray (10YR 4/1) silty clay, dark gray (10YR 4/1) and gray (10YR 5/1) dry; weak coarse blocky structure; extremely hard, very firm; common fine faint brown (10YR 5/3) and gray (10YR 5/1) mottles; many fine concretions of calcium carbonate; strong effervescence; moderately alkaline; diffuse smooth boundary.

Cg—50 to 60 inches; dark gray (10YR 4/1) silty clay, gray (10YR 5/1) dry; massive; very hard, very firm; many fine faint brown (10YR 5/3) mottles; many fine concretions of calcium carbonate; strong effervescence; moderately alkaline.

The depth to free lime is less than 10 inches. The mollic epipedon is more than 15 inches thick.

The A horizon has hue of 10YR, value of 3 or 4 (2 or 3 moist), and chroma of 1 or 2. It is mildly alkaline or moderately alkaline. The Bg horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 to 4 moist), and chroma of 1 or 2. In some pedons it has faint or distinct mottles in the lower part. The Cg horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 to 5 moist), and chroma of 1 or 2. It generally is mottled.

Sutphen Series

The Sutphen series consists of deep, moderately well drained, very slowly permeable soils on flood plains. These soils formed in clayey alluvium. Slopes are 0 to 1 percent.

Typical pedon of Sutphen silty clay, occasionally flooded, 2,050 feet north and 200 feet east of the southwest corner of sec. 21, T. 13 S., R. 1 W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) silty clay, black (10YR 2/1) moist; weak fine granular structure; hard, firm; few fine roots; slightly acid; abrupt smooth boundary.

A—6 to 35 inches; very dark gray (10YR 3/1) silty clay, black (10YR 2/1) moist; weak medium granular structure; very hard, very firm; few slickensides; neutral; clear wavy boundary.

AC—35 to 47 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; weak medium blocky structure; very hard, very firm; few slickensides; few small concretions of lime; slight effervescence; moderately alkaline; gradual wavy boundary.

C—47 to 60 inches; brown (10YR 5/3) silty clay, dark brown (10YR 4/3) moist; massive; very hard, very firm; mixed with some very dark gray (10YR 3/1) material from the upper horizons; common small

concretions of lime; slight effervescence; moderately alkaline.

The mollic epipedon is 24 to 48 inches thick. The depth to free lime is 20 to 36 inches.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It typically is silty clay, but the range includes silty clay loam. This horizon is slightly acid to moderately alkaline. The C horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3. It is silty clay in the upper part and silty clay or silty clay loam in the lower part. It is mildly alkaline or moderately alkaline.

Tobin Series

The Tobin series consists of deep, well drained, moderately permeable soils on narrow flood plains along upland drainageways. These soils formed in stratified, silty alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Tobin silt loam, occasionally flooded, 400 feet north and 300 feet west of the southeast corner of sec. 8, T. 15 S., R. 4 W.

A1—0 to 20 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; slightly hard, friable; common fine roots; slightly acid; gradual smooth boundary.

A2—20 to 38 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; common fine roots; neutral; gradual smooth boundary.

C1—38 to 56 inches; brown (10YR 5/3) silt loam, brown (10YR 4/3) moist; massive; slightly hard, friable; few fine roots; few thin strata of darker material; very slight effervescence; mildly alkaline; gradual smooth boundary.

C2—56 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable; few thin strata of darker material; few fine accumulations of lime; slight effervescence; mildly alkaline.

The mollic epipedon ranges from 20 to 40 inches in thickness. The depth to free carbonates ranges from 15 to 40 inches. The texture is silt loam, silty clay loam, or loam throughout the profile.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 to 3. It is slightly acid or neutral. The C horizon has hue of 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 1 to 3. It is mildly alkaline or moderately alkaline.

Wells Series

The Wells series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in material weathered from sandstone, in colluvium, and in old alluvium. Slopes range from 1 to 7 percent.

Typical pedon of Wells loam, 3 to 7 percent slopes, 500 feet south and 2,500 feet east of the northwest corner of sec. 8, T. 15 S., R. 5 W.

A—0 to 8 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; many fine roots; medium acid; gradual smooth boundary.

BA—8 to 13 inches; brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; moderate fine subangular blocky structure; slightly hard, friable; common fine roots; medium acid; gradual smooth boundary.

Bt1—13 to 20 inches; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; moderate fine subangular blocky structure; hard, firm; common fine roots; common faint clay films on faces of peds; slightly acid; gradual smooth boundary.

Bt2—20 to 38 inches; reddish yellow (5YR 6/6) clay loam, yellowish red (5YR 4/6) moist; moderate fine and medium blocky structure; hard, firm; few fine roots; few faint clay films on vertical faces of peds; slightly acid; gradual smooth boundary.

BC—38 to 48 inches; reddish yellow (7.5YR 6/8) clay loam, strong brown (7.5YR 5/8) moist; moderate fine blocky structure; hard, friable; slightly acid; gradual smooth boundary.

C—48 to 60 inches; reddish yellow (7.5YR 6/6) loam, strong brown (7.5YR 5/6) moist; massive; slightly hard, very friable; neutral.

The mollic epipedon ranges from 10 to 20 inches in thickness. Reaction is medium acid or slightly acid in the A horizon and slightly acid or neutral in the Bt and C horizons.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It typically is loam, but the range includes fine sandy loam, sandy loam, and clay loam. The Bt horizon has hue of 7.5YR or 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 to 6. It is clay loam or sandy clay loam. The C horizon has hue of 7.5YR or 5YR, value of 5 to 7 (5 or 6 moist), and chroma of 4 to 8. It is sandy loam, loam, sandy clay loam, or clay loam. In some pedons it has concretions of calcium carbonate.

Formation of the Soils

Soil forms through processes that act on deposited or accumulated geologic material. The characteristics of a soil at any given point are determined by the interaction of five factors of soil formation—climate, plants and other living organisms, parent material, relief, and time. Each of these factors influences the formation of every soil, and each modifies the effects of the other four. The relative effects of the individual factors vary from place to place. The interactions among the factors are more complex for some soils than for others.

Climate and vegetation act on the parent material and gradually change it into a natural body of soil. Relief modifies the effects of climate and vegetation, mainly through its effect on runoff and temperature. The nature of the parent material affects the kind of soil that forms. Time is needed for the transformation of the parent material into a soil. Generally, a long period is needed for the formation of distinct soil horizons.

Parent Material

Parent material is the weathered rocks or partly weathered material in which soils form. It affects the texture, structure, color, natural fertility, and many other properties of the soil. The soils in Saline County formed in alluvium, loess, and residuum of limestone, shale, or sandstone *(5)*.

Alluvium is sediment deposited by floodwater in stream valleys. The alluvium in Saline County generally is silty, but in a few areas it is sandy loam. Cass, Detroit, Hord, McCook, Roxbury, and Tobin soils formed in alluvial material.

Loess is silty, wind-deposited material, some of which was carried hundreds of miles from its source. Peorian Loess of the Wisconsin Glaciation was deposited during the Pleistocene. It covers many of the uplands in the county. In most places it is very pale brown or light gray and is calcareous and friable. Crete soils formed in this material. Geary and Longford soils formed in Loveland Loess, which is reddish brown material deposited during Illinoian time.

The bedrock that crops out in Saline County is limestone, shale, or sandstone. The limestone and shale are of the Permian System. The calcareous Clime and Kipson soils formed in residuum of these rocks. Edalgo, Hedville, and Lancaster soils formed in material weathered from shale or sandstone of the Dakota Formation, which is in the Lower Cretaceous System (fig. 18).

Climate

Climate affects the physical and chemical weathering and biological processes at work in the parent material. These processes are most active when the soil is warm and moist.

The continental climate of Saline County is characterized by intermittent dry and moist periods. These periods can last for less than a year or for several years. The soil material dries to varying depths during dry periods. It slowly regains moisture during wet periods and can become saturated with excess moisture. The accumulation of lime in the lower part of the subsoil in Crete soils is an indication of this excess moisture. The downward movement of water is of major importance in transforming the parent material into a soil that has distinct horizons.

Climate is an important factor affecting soil formation throughout a wide region, but it does not significantly differentiate soils in a small area, such as a county.

Plant and Animal Life

Plants generally affect the content of plant nutrients and organic matter in the soil and the color of the surface layer. Bacteria and fungi help to decompose the plants, thus releasing more nutrients. Earthworms, cicadas, and burrowing animals help to keep the soil open and porous.

Mid and tall prairie grasses have had a significant effect on soil formation in Saline County. As a result of the grasses, the upper part of a typical soil in the county is dark and is high in organic matter content. In many areas the next part is slightly finer textured and somewhat lighter colored than the layer above. The underlying parent material generally is light in color and high in content of lime.

Human activities, such as farming and ranching,

Figure 18.—Sandstone and shale of the Dakota Formation. Edalgo, Hedville, and Lancaster soils formed in material weathered from this formation.

have a great effect on soil formation. In many areas in the county, they have increased the susceptibility to erosion and decreased the content of organic matter. Also, land leveling and industrial or urban development have altered the relief.

Relief

Relief affects soil formation through its effect on drainage, runoff, plant cover, and soil temperature. Most important is the effect that it has on the movement of water on the surface and into the soil.

Runoff is more rapid on the steeper soils in the uplands than on less sloping soils. As a result, erosion is more extensive. Relief has retarded the formation of Hedville soils, which formed in some of the oldest parent material in the county. Runoff is rapid on these moderately sloping to moderately steep soils, and much of the soil material is removed as soon as the soil forms.

Time

The length of time needed for soil formation depends mainly on the other factors of soil formation. As water moves downward through the soil, soluble material and fine particles are leached gradually from the surface layer and are deposited in the subsoil. The extent of leaching depends not only on the amount of water that has penetrated the surface but also on the amount of time that has elapsed.

Some of the soils in the county are young. McCook

soils, which formed in recent alluvium, are an example. They show very little evidence of horizon differentiation other than a slight darkening of the surface layer. The older soils have well defined horizons. Crete soils, which have been forming for thousands of years, are an example.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Catsteps. Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Clayey soil. Clay, sandy clay, or silty clay.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and

deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Fine textured soil. Sandy clay, silty clay, or clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter

represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows—

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loamy soil. Coarse sandy loam, sandy loam, fine sandy loam, very fine sandy loam, loam, clay loam, or sandy clay loam.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are—

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range in moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending

through all its horizons and into the parent material.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are—

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sandy soil. Coarse sand, sand, fine sand, very fine sand, loamy coarse sand, loamy sand, loamy fine sand, or loamy very fine sand.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Silty soil. Silt, silt loam, or silty clay loam.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. The terms used to describe slope in this survey are—

Nearly level	0 to 2 percent
Gently sloping	1 to 3 percent
Moderately sloping	2 to 7 percent
Strongly sloping	6 to 15 percent
Moderately steep	15 to 20 percent

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows—

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the substratum. The living roots and plant and animal activities are largely confined to the solum.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a

crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-80 at Salina, Kansas)

Month	Temperature					Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	In	In	In		In
January----	37.8	16.8	27.3	64	-10	0.71	0.13	1.33	2	5.3
February---	44.2	21.7	33.0	76	-6	.85	.17	1.45	2	5.2
March------	53.8	30.3	42.1	80	1	1.98	.86	2.43	4	3.8
April------	66.5	42.4	54.5	86	22	2.70	1.40	4.23	5	.5
May--------	76.1	53.1	64.6	92	34	4.15	2.00	6.16	7	.0
June-------	87.0	63.3	75.2	104	49	4.19	1.79	6.93	6	.0
July-------	92.7	68.8	80.8	105	53	3.31	1.42	4.50	5	.0
August-----	91.3	67.0	79.2	104	54	3.03	1.16	4.64	4	.0
September--	81.4	57.4	69.4	100	38	3.51	.95	6.07	5	.0
October----	70.6	45.4	58.0	92	26	2.41	.27	4.42	4	.1
November---	53.9	31.7	42.8	78	6	1.22	.14	2.37	2	1.4
December---	43.0	22.2	32.6	66	-4	.89	.23	1.43	2	3.9
Year-----	66.5	43.3	55.0	108	-13	28.95	21.03	36.38	48	20.2

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 16	Apr. 25	May 4
2 years in 10 later than--	Apr. 10	Apr. 19	Apr. 28
5 years in 10 later than--	Mar. 28	Apr. 9	Apr. 18
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 20	Oct. 17	Oct. 9
2 years in 10 earlier than--	Oct. 26	Oct. 21	Oct. 13
5 years in 10 earlier than--	Nov. 7	Oct. 30	Oct. 21

TABLE 3.--GROWING SEASON

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	192	182	166
8 years in 10	203	189	172
5 years in 10	223	203	185
2 years in 10	243	217	198
1 year in 10	254	224	205

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Ba	Bavaria-Detroit complex	3,750	0.8
Cd	Cass fine sandy loam, occasionally flooded	2,150	0.5
Ce	Clime silty clay loam, 2 to 6 percent slopes	8,850	1.9
Co	Cozad silt loam	6,200	1.3
Cr	Crete silt loam, 0 to 2 percent slopes	25,250	5.5
Cs	Crete silt loam, 2 to 5 percent slopes	25,750	5.6
Cx	Crete-Wells complex, 2 to 7 percent slopes	27,250	5.9
De	Detroit silty clay loam	27,750	6.0
Ed	Edalgo clay loam, 3 to 7 percent slopes	11,700	2.5
Ge	Geary silt loam, 1 to 3 percent slopes	1,850	0.4
Gf	Geary silt loam, 3 to 7 percent slopes	5,100	1.1
Ho	Hord silt loam	20,750	4.5
Ir	Irwin silty clay loam, 1 to 3 percent slopes	11,400	2.5
Is	Irwin silty clay loam, 3 to 7 percent slopes	9,100	2.0
Kc	Kipson-Clime complex, 6 to 20 percent slopes	5,500	1.2
Lf	Lancaster loam, 3 to 7 percent slopes	8,400	1.8
Lh	Lancaster-Hedville complex, 3 to 20 percent slopes	93,400	20.2
Lm	Longford silt loam, 1 to 3 percent slopes	10,750	2.3
Lo	Longford silt loam, 3 to 7 percent slopes	27,000	5.8
Mc	McCook silt loam	18,500	4.0
Ne	New Cambria silty clay	6,750	1.5
Ot	Ortello fine sandy loam, 2 to 6 percent slopes	1,200	0.3
Ov	Orthents, clayey	715	0.2
Ro	Roxbury silt loam	13,000	2.8
Sm	Smolan silt loam, 0 to 2 percent slopes	1,400	0.3
So	Solomon silty clay, occasionally flooded	1,550	0.3
St	Sutphen silty clay, occasionally flooded	18,800	4.1
To	Tobin silt loam, occasionally flooded	36,230	7.9
Wr	Wells loam, 1 to 3 percent slopes	6,200	1.3
Ws	Wells loam, 3 to 7 percent slopes	25,400	5.5
	Total	461,645	100.0

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland)

Map symbol	Soil name
Cd	Cass fine sandy loam, occasionally flooded
Co	Cozad silt loam
Cr	Crete silt loam, 0 to 2 percent slopes
Cs	Crete silt loam, 2 to 5 percent slopes
Cx	Crete-Wells complex, 2 to 7 percent slopes
De	Detroit silty clay loam
Ge	Geary silt loam, 1 to 3 percent slopes
Gf	Geary silt loam, 3 to 7 percent slopes
Ho	Hord silt loam
Ir	Irwin silty clay loam, 1 to 3 percent slopes
Is	Irwin silty clay loam, 3 to 7 percent slopes
Lf	Lancaster loam, 3 to 7 percent slopes
Lm	Longford silt loam, 1 to 3 percent slopes
Lo	Longford silt loam, 3 to 7 percent slopes
Mc	McCook silt loam
Ne	New Cambria silty clay
Ot	Ortello fine sandy loam, 2 to 6 percent slopes
Ro	Roxbury silt loam
Sm	Smolan silt loam, 0 to 2 percent slopes
St	Sutphen silty clay, occasionally flooded
To	Tobin silt loam, occasionally flooded
Wr	Wells loam, 1 to 3 percent slopes
Ws	Wells loam, 3 to 7 percent slopes

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Winter wheat	Grain sorghum	Soybeans	Smooth bromegrass	Alfalfa hay
		Bu	Bu	Bu	AUM*	Tons
Ba----------------------- Bavaria-Detroit	IIIs	35	54	---	4.5	2.2
Cd----------------------- Cass	IIw	38	58	---	5.5	4.0
Ce----------------------- Clime	IVe	22	32	---	4.0	1.6
Co----------------------- Cozad	I	42	72	33	5.5	4.0
Cr----------------------- Crete	IIs	35	56	26	5.0	2.9
Cs----------------------- Crete	IIIe	30	50	22	4.5	2.5
Cx----------------------- Crete-Wells	IIIe	30	48	22	4.5	2.9
De----------------------- Detroit	I	39	62	30	5.5	4.0
Ed----------------------- Edalgo	IVe	27	43	---	4.5	2.0
Ge----------------------- Geary	IIe	37	58	28	5.5	3.4
Gf----------------------- Geary	IIIe	34	55	25	5.0	3.0
Ho----------------------- Hord	I	42	67	33	5.5	4.0
Ir----------------------- Irwin	IIIe	33	52	24	5.0	3.0
Is----------------------- Irwin	IVe	30	48	---	4.5	2.6
Kc----------------------- Kipson-Clime	VIe	---	---	---	---	---
Lf----------------------- Lancaster	IVe	29	46	---	4.5	2.5
Lh----------------------- Lancaster-Hedville	VIe	---	---	---	---	---
Lm----------------------- Longford	IIe	35	55	25	5.0	3.0
Lo----------------------- Longford	IIIe	33	52	22	4.5	2.5

See footnote at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Winter wheat	Grain sorghum	Soybeans	Smooth bromegrass	Alfalfa hay
		Bu	Bu	Bu	AUM*	Tons
Mc------------------------ McCook	I	38	57	33	6.0	4.0
Ne------------------------ New Cambria	IIs	35	54	30	5.0	3.5
Ot------------------------ Ortello	IIIe	30	53	20	2.7	2.8
Ov. Orthents						
Ro------------------------ Roxbury	I	40	60	33	5.5	4.0
Sm------------------------ Smolan	I	34	52	26	5.5	3.0
So------------------------ Solomon	IIIw	20	40	25	5.5	3.0
St------------------------ Sutphen	IIw	35	55	28	5.5	3.0
To------------------------ Tobin	IIw	42	68	33	5.5	4.0
Wr------------------------ Wells	IIe	36	57	30	5.5	4.0
Ws------------------------ Wells	IIIe	33	53	27	5.5	3.5

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 7.--RANGELAND PRODUCTIVITY

(Only the soils that support rangeland vegetation suitable for grazing are listed)

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
Ba*:				
Bavaria	Saline Lowland	6,500	5,500	4,000
Detroit	Loamy Terrace	5,500	4,500	3,000
Cd Cass	Sandy Lowland	5,500	4,000	3,000
Ce Clime	Limy Upland	4,500	3,500	2,500
Co Cozad	Loamy Terrace	6,000	5,000	4,000
Cr, Cs Crete	Clay Upland	4,500	3,500	2,000
Cx*:				
Crete	Clay Upland	4,500	3,500	2,000
Wells	Loamy Upland	5,000	4,000	2,500
De Detroit	Loamy Terrace	5,500	4,500	3,000
Ed Edalgo	Clay Upland	4,000	3,000	2,000
Ge, Gf Geary	Loamy Upland	5,000	4,000	3,000
Ho Hord	Loamy Terrace	5,500	4,500	3,000
Ir, Is Irwin	Clay Upland	4,500	3,500	2,000
Kc*:				
Kipson	Limy Upland	4,000	3,000	2,000
Clime	Limy Upland	4,500	3,500	2,500
Lf Lancaster	Loamy Upland	4,500	4,000	3,000
Lh*:				
Lancaster	Loamy Upland	4,500	4,000	3,000
Hedville	Shallow Sandstone	4,000	3,000	2,000
Lm, Lo Longford	Loamy Upland	4,500	4,000	3,000
Mc McCook	Loamy Terrace	5,500	4,000	3,000
Ne New Cambria	Clay Terrace	5,000	4,000	3,000

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season: Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
Ot-----------------------Ortello	Sandy	4,000	3,000	2,000
Ro-----------------------Roxbury	Loamy Terrace	5,500	4,500	3,000
Sm-----------------------Smolan	Loamy Upland	4,500	4,000	3,000
So-----------------------Solomon	Clay Lowland	5,500	4,500	3,000
St-----------------------Sutphen	Clay Lowland	5,500	4,500	3,000
To-----------------------Tobin	Loamy Lowland	6,000	5,000	4,000
Wr, Ws-------------------Wells	Loamy Upland	5,000	4,000	2,500

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ba*:					
Bavaria	Lilac, tamarisk, silver buffaloberry.	Eastern redcedar, Russian olive, Rocky Mountain juniper, Siberian peashrub.	Ponderosa pine, golden willow, green ash, Siberian elm.	---	Eastern cottonwood.
Detroit	American plum	Amur honeysuckle, lilac.	Eastern redcedar, Austrian pine, Russian olive, ponderosa pine, green ash, Russian mulberry.	Hackberry, honeylocust.	Eastern cottonwood.
Cd-- Cass	---	Peking cotoneaster, Amur honeysuckle, lilac, American plum.	Eastern redcedar	Austrian pine, hackberry, eastern white pine, honeylocust, bur oak, green ash.	Eastern cottonwood.
Ce-- Clime	Fragrant sumac	Siberian peashrub	Eastern redcedar, green ash, Osageorange, Russian olive, black locust, honeylocust, northern catalpa, bur oak.	Siberian elm	---
Co-- Cozad	American plum	Lilac, Amur honeysuckle.	Eastern redcedar, Austrian pine, Russian olive, ponderosa pine, green ash, Russian mulberry.	Hackberry, honeylocust.	Eastern cottonwood.
Cr, Cs-- Crete	Lilac, Peking cotoneaster.	Manchurian crabapple, Amur honeysuckle, Austrian pine, Siberian peashrub.	Eastern redcedar, hackberry, Russian olive, green ash.	Honeylocust, Siberian elm.	---
Cx*:					
Crete	Lilac, Peking cotoneaster.	Manchurian crabapple, Amur honeysuckle, Austrian pine, Siberian peashrub.	Eastern redcedar, hackberry, Russian olive, green ash.	Honeylocust, Siberian elm.	---
Wells	Peking cotoneaster	Fragrant sumac, Amur honeysuckle, lilac.	Russian olive, eastern redcedar, hackberry, bur oak, green ash.	Austrian pine, Scotch pine, honeylocust.	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
De-----------------Detroit	American plum-----	Amur honeysuckle, lilac.	Eastern redcedar, Austrian pine, Russian olive, ponderosa pine, green ash, Russian mulberry.	Hackberry, honeylocust.	Eastern cottonwood.
Ed-----------------Edalgo	Siberian peashrub, Amur honeysuckle, Peking cotoneaster.	Eastern redcedar, Rocky Mountain juniper, hackberry.	Austrian pine, honeylocust, Russian olive, green ash, Russian mulberry.	Siberian elm------	---
Ge, Gf------------Geary	Peking cotoneaster	Lilac, fragrant sumac, Amur honeysuckle.	Eastern redcedar, hackberry, bur oak, green ash, Russian olive.	Scotch pine, Austrian pine, honeylocust.	---
Ho-----------------Hord	Peking cotoneaster	Lilac, Siberian peashrub, American plum.	Eastern redcedar, ponderosa pine, blue spruce, Manchurian crabapple.	Golden willow, green ash, hackberry.	Eastern cottonwood.
Ir, Is------------Irwin	Lilac, Peking cotoneaster.	Manchurian crabapple, Amur honeysuckle, Siberian peashrub.	Austrian pine, eastern redcedar, hackberry, green ash, Russian olive.	Siberian elm, honeylocust.	---
Kc*: Kipson.					
Clime------------	Fragrant sumac----	Siberian peashrub	Eastern redcedar, green ash, Osageorange, Russian olive, black locust, honeylocust, northern catalpa, bur oak.	Siberian elm------	---
Lf-----------------Lancaster	Fragrant sumac, lilac, Siberian peashrub.	Rocky Mountain juniper, Russian mulberry, Russian olive.	Eastern redcedar, green ash, Austrian pine, bur oak, honeylocust.	Siberian elm------	---
Lh*: Lancaster---------	Fragrant sumac, lilac, Siberian peashrub.	Rocky Mountain juniper, Russian mulberry, Russian olive.	Eastern redcedar, green ash, Austrian pine, bur oak, honeylocust.	Siberian elm------	---
Hedville.					

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Lm, Lo: Longford	Lilac, fragrant sumac, Amur honeysuckle.	Russian mulberry	Eastern redcedar, bur oak, honeylocust, green ash, Austrian pine, hackberry, Russian olive.	Siberian elm	---
Mc: McCook	American plum, lilac.	Fragrant sumac, silver buffaloberry.	Eastern redcedar, green ash, Russian mulberry, ponderosa pine, Russian olive, hackberry.	Honeylocust, Siberian elm.	Eastern cottonwood.
Ne: New Cambria	---	Siberian peashrub, silver buffaloberry.	Eastern redcedar, Russian olive, ponderosa pine, green ash, Russian mulberry.	Siberian elm, hackberry, honeylocust.	Eastern cottonwood.
Ot: Ortello	Skunkbush sumac	American plum, Siberian peashrub, lilac.	Eastern redcedar, honeylocust, ponderosa pine, Russian olive, hackberry, green ash.	---	Siberian elm.
Ov. Orthents					
Ro: Roxbury	American plum	Amur honeysuckle, lilac.	Russian mulberry, ponderosa pine, green ash, Russian olive, Austrian pine, eastern redcedar.	Hackberry, honeylocust.	Eastern cottonwood.
Sm: Smolan	Lilac	Amur honeysuckle, Peking cotoneaster, Siberian peashrub, Manchurian crabapple.	Eastern redcedar, Austrian pine, Russian olive, green ash, hackberry.	Siberian elm, honeylocust.	---
So: Solomon	Fragrant sumac	Common chokecherry, American plum.	Eastern redcedar, hackberry, Russian mulberry, Midwest Manchurian crabapple.	Siberian elm, green ash, golden willow, honeylocust.	Eastern cottonwood.
St: Sutphen	Amur honeysuckle, Siberian peashrub, Peking cotoneaster.	Eastern redcedar, hackberry, Russian olive, green ash, Rocky Mountain juniper.	Austrian pine, Russian mulberry, honeylocust.	Siberian elm	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
To----------------- Tobin	American plum-----	Lilac, Amur honeysuckle.	Eastern redcedar, Russian olive, Austrian pine, green ash, ponderosa pine, Russian mulberry.	Hackberry, honeylocust.	Eastern cottonwood.
Wr, Ws------------ Wells	Peking cotoneaster	Fragrant sumac, Amur honeysuckle, lilac.	Russian olive, eastern redcedar, hackberry, bur oak, green ash.	Austrian pine, Scotch pine, honeylocust.	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe")

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Ba*:				
Bavaria	Severe: flooding, excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
Detroit	Severe: flooding.	Slight	Slight	Slight.
Cd: Cass	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Ce: Clime	Slight	Slight	Moderate: slope, thin layer.	Severe: erodes easily.
Co: Cozad	Severe: flooding.	Slight	Slight	Slight.
Cr: Crete	Slight	Slight	Slight	Slight.
Cs: Crete	Slight	Slight	Moderate: slope.	Slight.
Cx*:				
Crete	Slight	Slight	Moderate: slope.	Slight.
Wells	Slight	Slight	Moderate: slope.	Slight.
De: Detroit	Severe: flooding.	Slight	Slight	Slight.
Ed: Edalgo	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones, thin layer.	Slight.
Ge, Gf: Geary	Slight	Slight	Moderate: slope.	Slight.
Ho: Hord	Severe: flooding.	Slight	Slight	Slight.
Ir, Is: Irwin	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight.
Kc*:				
Kipson	Severe: thin layer, area reclaim.	Severe: thin layer, area reclaim.	Severe: small stones, thin layer, area reclaim.	Slight.
Clime	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Lf: Lancaster	Slight	Slight	Moderate: slope, thin layer.	Slight.
Lh*:				
Lancaster	Slight	Slight	Severe: slope.	Slight.
Hedville	Severe: thin layer, area reclaim.	Severe: thin layer, area reclaim.	Severe: slope, small stones.	Slight.
Lm, Lo: Longford	Slight	Slight	Moderate: slope.	Slight.
Mc: McCook	Severe: flooding.	Slight	Slight	Slight.
Ne: New Cambria	Severe: flooding.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
Ot: Ortello	Slight	Slight	Moderate: slope.	Slight.
Ov: Orthents	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: percs slowly.	Slight.
Ro: Roxbury	Severe: flooding.	Slight	Slight	Slight.
Sm: Smolan	Slight	Slight	Slight	Slight.
So: Solomon	Severe: flooding, wetness, percs slowly.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey, wetness.	Severe: wetness, too clayey.
St: Sutphen	Severe: flooding.	Moderate: too clayey, percs slowly.	Moderate: too clayey, flooding, percs slowly.	Moderate: too clayey.
To: Tobin	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Wr, Ws: Wells	Slight	Slight	Moderate: slope.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Ba*:												
Bavaria	Good	Good	Good	---	---	Good	Good	Good	Good	---	Good	Good.
Detroit	Good	Good	Good	---	---	Good	Good	Good	Good	---	Good	Good.
Cd Cass	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Ce Clime	Fair	Fair	Good	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Co Cozad	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Cr Crete	Good	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
Cs Crete	Fair	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Good.
Cx*:												
Crete	Fair	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Good.
Wells	Good	Good	Good	---	---	Fair	Very poor.	Very poor.	Good	---	Very poor.	Fair.
De Detroit	Good	Good	Good	---	---	Good	Good	Good	Good	---	Good	Good.
Ed Edalgo	Good	Good	Good	---	---	Fair	Very poor.	Very poor.	Good	---	Very poor.	Good.
Ge Geary	Good	Good	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor	Good.
Gf Geary	Fair	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
Ho Hord	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Ir Irwin	Good	Good	Good	---	---	Fair	Poor	Poor	Good	---	Poor	Fair.
Is Irwin	Fair	Good	Good	---	---	Fair	Poor	Poor	Fair	---	Poor	Fair.
Kc*:												
Kipson	Poor	Fair	Fair	---	---	Poor	Very poor.	Very poor.	Fair	---	Very poor.	Poor.
Clime	Fair	Fair	Good	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Lf----------------- Lancaster	Fair	Good	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Lh*:												
Lancaster---------	Fair	Good	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Hedville----------	Very poor.	Poor	Poor	---	---	Poor	Very poor.	Very poor.	Poor	---	Very poor.	Poor.
Lm----------------- Longford	Good	Good	Fair	---	---	Fair	Poor	Fair	Good	---	Poor	Fair.
Lo----------------- Longford	Fair	Good	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Mc----------------- McCook	Good	Good	Good	Good	Fair	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
Ne----------------- New Cambria	Fair	Fair	Poor	Good	Good	Fair	Poor	Poor	Fair	Good	Poor	Poor.
Ot----------------- Ortello	Fair	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Ov----------------- Orthents	Very poor.	Poor	Good	Fair	Fair	Fair	Poor	Poor	Poor	Fair	Poor	Fair.
Ro----------------- Roxbury	Good	Good	Good	Fair	Fair	Fair	Poor	Fair	Good	Fair	Poor	Fair.
Sm----------------- Smolan	Good	Good	Fair	---	---	Fair	Poor	Fair	Good	---	Poor	Fair.
So----------------- Solomon	Fair	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good	Fair.
St----------------- Sutphen	Fair	Fair	Fair	Fair	Fair	Fair	Poor	Good	Fair	Fair	Fair	Fair.
To----------------- Tobin	Good	Good	Good	Good	Good	Good	Poor	Fair	Good	Good	Poor	Good.
Wr, Ws------------- Wells	Good	Good	Good	---	---	Fair	Very poor.	Very poor.	Good	---	Very poor.	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Ba*:					
Bavaria	Moderate: too clayey.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength.
Detroit	Moderate: too clayey.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.
Cd: Cass	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Ce: Clime	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Co: Cozad	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, frost action.
Cr, Cs: Crete	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Cx*:					
Crete	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Wells	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
De: Detroit	Moderate: too clayey.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.
Ed: Edalgo	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Ge: Geary	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.
Gf: Geary	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.
Ho: Hord	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.
Ir, Is: Irwin	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Kc*:					
Kipson	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, slope.	Severe: slope.	Moderate: shrink-swell, slope, low strength.
Clime	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.
Lf Lancaster	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.
Lh*:					
Lancaster	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.
Hedville	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.
Lm, Lo Longford	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Mc McCook	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, frost action.
Ne New Cambria	Moderate: too clayey.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.
Ot Ortello	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.
Ov Orthents	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Ro Roxbury	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.
Sm Smolan	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
So Solomon	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.
St Sutphen	Moderate: too clayey, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, flooding, shrink-swell.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
To----------------- Tobin	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.
Wr----------------- Wells	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Ws----------------- Wells	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ba*:					
Bavaria	Severe: percs slowly.	Moderate: seepage.	Severe: too clayey, excess sodium.	Moderate: flooding.	Poor: too clayey, hard to pack, excess sodium.
Detroit	Severe: percs slowly.	Slight	Severe: too clayey.	Moderate: flooding.	Poor: too clayey, hard to pack.
Cd: Cass	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Fair: thin layer.
Ce: Clime	Severe: thin layer, seepage, percs slowly.	Severe: seepage.	Severe: seepage, too clayey.	Moderate: seepage.	Poor: area reclaim, too clayey, hard to pack.
Co: Cozad	Moderate: flooding.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
Cr: Crete	Severe: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Poor: hard to pack.
Cs: Crete	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Poor: hard to pack.
Cx*:					
Crete	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Poor: hard to pack.
Wells	Slight	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
De: Detroit	Severe: percs slowly.	Slight	Severe: too clayey.	Moderate: flooding.	Poor: too clayey, hard to pack.
Ed: Edalgo	Severe: thin layer, seepage, percs slowly.	Severe: seepage.	Severe: seepage, too clayey.	Moderate: seepage.	Poor: area reclaim, too clayey, hard to pack.
Ge, Gf: Geary	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Ho: Hord	Moderate: flooding.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ir, Is-------------- Irwin	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
Kc*:					
Kipson-------------	Severe: thin layer, seepage.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: area reclaim, small stones.
Clime--------------	Severe: thin layer, seepage, percs slowly.	Severe: seepage, slope.	Severe: seepage, too clayey.	Moderate: seepage, slope.	Poor: area reclaim, too clayey, hard to pack.
Lf----------------- Lancaster	Severe: thin layer, seepage.	Severe: seepage.	Severe: seepage.	Moderate: seepage.	Poor: area reclaim, thin layer.
Lh*:					
Lancaster----------	Severe: thin layer, seepage.	Severe: seepage, slope.	Severe: seepage.	Moderate: seepage.	Poor: area reclaim, thin layer.
Hedville-----------	Severe: thin layer, seepage.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage.	Severe: seepage.	Poor: area reclaim, thin layer.
Lm, Lo-------------- Longford	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
Mc----------------- McCook	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
Ne----------------- New Cambria	Severe: percs slowly.	Slight-----------	Severe: too clayey.	Moderate: flooding.	Poor: too clayey, hard to pack.
Ot----------------- Ortello	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Ov----------------- Orthents	Severe: percs slowly.	Slight-----------	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
Ro----------------- Roxbury	Moderate: flooding.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
Sm----------------- Smolan	Severe: percs slowly.	Moderate: seepage.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
So----------------- Solomon	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
St------------------ Sutphen	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
To------------------ Tobin	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
Wr, Ws-------------- Wells	Slight-----------	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ba*:				
Bavaria	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess sodium, excess salt.
Detroit	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Cd Cass	Good	Probable	Improbable: too sandy.	Good.
Ce Clime	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, too clayey.
Co Cozad	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Cr, Cs Crete	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Cx*:				
Crete	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Wells	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
De Detroit	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Ed Edalgo	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Ge, Gf Geary	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Ho Hord	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ir, Is Irwin	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Kc*:				
Kipson	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, thin layer.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Kc*:				
Clime	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, too clayey.
Lf Lancaster	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones, thin layer.
Lh*:				
Lancaster	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones, thin layer.
Hedville	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, thin layer.
Lm, Lo Longford	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Mc McCook	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Ne New Cambria	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Ot Ortello	Good	Probable	Improbable: too sandy.	Fair: thin layer.
Ov Orthents	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Ro Roxbury	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Sm Smolan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
So Solomon	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, too clayey.
St Sutphen	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
To Tobin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Wr, Ws Wells	Good	Improbable: excess fines.	Improbable: excess fines.	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Ba*:						
Bavaria	Slight	Severe: excess sodium.	Deep to water	Percs slowly, erodes easily, excess sodium.	Erodes easily, percs slowly.	Excess sodium, erodes easily, percs slowly.
Detroit	Slight	Moderate: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Cd Cass	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, flooding.	Soil blowing	Favorable.
Ce Clime	Moderate: seepage, slope.	Moderate: thin layer, hard to pack.	Deep to water	Slope, percs slowly, thin layer.	Area reclaim, erodes easily.	Erodes easily, area reclaim.
Co Cozad	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
Cr Crete	Moderate: seepage.	Moderate: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily	Erodes easily, percs slowly.
Cs Crete	Moderate: seepage, slope.	Moderate: hard to pack.	Deep to water	Percs slowly, slope, erodes easily.	Erodes easily	Erodes easily, percs slowly.
Cx*:						
Crete	Moderate: seepage, slope.	Moderate: hard to pack.	Deep to water	Percs slowly, slope, erodes easily.	Erodes easily	Erodes easily, percs slowly.
Wells	Moderate: seepage, slope.	Moderate: thin layer, piping.	Deep to water	Slope	Favorable	Favorable.
De Detroit	Slight	Moderate: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Ed Edalgo	Moderate: seepage, slope.	Moderate: thin layer, hard to pack.	Deep to water	Percs slowly, thin layer, slope.	Area reclaim, erodes easily.	Erodes easily, area reclaim.
Ge Geary	Moderate: seepage.	Slight	Deep to water	Favorable	Erodes easily	Erodes easily.
Gf Geary	Moderate: seepage, slope.	Slight	Deep to water	Slope	Erodes easily	Erodes easily.
Ho Hord	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable	Favorable	Favorable.
Ir Irwin	Slight	Severe: hard to pack.	Deep to water	Percs slowly	Erodes easily, percs slowly.	Erodes easily, percs slowly.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Is----------------- Irwin	Moderate: slope.	Severe: hard to pack.	Deep to water	Slope, percs slowly.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Kc*:						
Kipson-----------	Severe: seepage, slope.	Severe: piping, thin layer.	Deep to water	Slope, thin layer.	Slope, large stones, area reclaim.	Large stones, slope, area reclaim.
Clime------------	Severe: slope.	Moderate: thin layer, hard to pack.	Deep to water	Slope, percs slowly, thin layer.	Slope, area reclaim, erodes easily.	Slope, erodes easily, area reclaim.
Lf----------------- Lancaster	Moderate: seepage, slope.	Severe: thin layer.	Deep to water	Thin layer, slope.	Area reclaim---	Area reclaim.
Lh*:						
Lancaster--------	Moderate: seepage, slope.	Severe: thin layer.	Deep to water	Thin layer, slope.	Area reclaim---	Area reclaim.
Hedville---------	Severe: depth to rock, seepage, slope.	Severe: piping, thin layer.	Deep to water	Slope, thin layer.	Slope, large stones, depth to rock.	Slope, depth to rock, area reclaim.
Lm---------------- Longford	Slight---------	Moderate: hard to pack.	Deep to water	Percs slowly---	Percs slowly---	Percs slowly.
Lo----------------- Longford	Moderate: slope.	Moderate: hard to pack.	Deep to water	Percs slowly, slope.	Percs slowly---	Percs slowly.
Mc---------------- McCook	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
Ne---------------- New Cambria	Slight---------	Severe: hard to pack.	Deep to water	Slow intake, percs slowly.	Percs slowly---	Percs slowly.
Ot---------------- Ortello	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, soil blowing.	Too sandy, soil blowing.	Favorable.
Ov---------------- Orthents	Slight---------	Moderate: thin layer, hard to pack.	Deep to water	Droughty, percs slowly.	Percs slowly---	Droughty, percs slowly.
Ro---------------- Roxbury	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
Sm---------------- Smolan	Slight---------	Moderate: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
So---------------- Solomon	Slight---------	Severe: hard to pack, wetness.	Percs slowly, flooding.	Wetness, droughty, slow intake.	Wetness, percs slowly.	Wetness, droughty, percs slowly.
St---------------- Sutphen	Slight---------	Moderate: hard to pack.	Deep to water	Slow intake, percs slowly, flooding.	Percs slowly---	Percs slowly.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
To-----------------Tobin	Moderate: seepage.	Moderate: piping.	Deep to water	Flooding--------	Favorable-------	Favorable.
Wr-----------------Wells	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Favorable-------	Favorable-------	Favorable.
Ws-----------------Wells	Moderate: seepage, slope.	Moderate: thin layer, piping.	Deep to water	Slope-----------	Favorable-------	Favorable.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Ba*:											
Bavaria	0-6	Silt loam	CL	A-6	0	100	100	90-100	85-100	35-40	15-20
	6-13	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	90-100	85-100	35-50	15-30
	13-35	Silty clay loam, silty clay.	CH	A-7	0	100	100	95-100	85-100	50-60	30-35
	35-45	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	95-100	85-100	35-50	15-30
	45-60	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	95-100	85-100	35-50	15-30
Detroit	0-7	Silt loam	CL	A-6, A-4	0	100	100	95-100	85-95	25-40	8-20
	7-38	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	90-100	50-60	25-35
	38-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	95-100	85-100	25-45	10-25
Cd: Cass	0-13	Fine sandy loam	SM, SM-SC	A-4, A-2	0	100	95-100	85-95	20-40	<20	NP-5
	13-60	Fine sandy loam, sandy loam, very fine sandy loam.	SM, SM-SC	A-4, A-2	0	100	95-100	85-95	20-50	<20	NP-5
Ce: Clime	0-8	Silty clay loam	CL	A-6, A-7	0-5	90-100	90-100	85-100	80-95	40-50	20-25
	8-20	Silty clay, clay, silty clay loam.	CH, CL	A-7, A-6	0	95-100	95-100	95-100	85-95	45-65	20-40
	20-28	Silty clay, clay, silty clay loam.	CL, CH	A-7	0	95-100	95-100	95-100	85-95	45-60	20-30
	28	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Co: Cozad	0-14	Silt loam	ML, CL, CL-ML	A-4, A-6	0	100	100	100	75-100	20-35	2-12
	14-36	Silt loam, very fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0	95-100	95-100	90-100	80-95	20-35	2-12
	36-60	Silt loam, very fine sandy loam, fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0	95-100	95-100	80-100	50-100	20-35	2-12
Cr, Cs: Crete	0-10	Silt loam	CL, ML	A-4, A-6	0	100	100	100	90-100	30-40	5-15
	10-16	Silty clay loam	CL	A-6, A-7	0	100	100	100	90-100	35-50	15-30
	16-44	Silty clay, silty clay loam.	CH	A-7	0	100	100	100	90-100	50-65	25-40
	44-60	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	100	95-100	30-55	10-35
Cx*:											
Crete	0-10	Silt loam	CL, ML	A-4, A-6	0	100	100	100	90-100	30-40	5-15
	10-16	Silty clay loam	CL	A-6, A-7	0	100	100	100	90-100	35-50	15-30
	16-44	Silty clay, silty clay loam.	CH	A-7	0	100	100	100	90-100	50-65	25-40
	44-60	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	100	95-100	30-55	10-35

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
Cx*: Wells-----------	0-13	Loam-------------	CL-ML, CL	A-4, A-6	0	100	100	95-100	65-85	20-35	5-20
	13-38	Clay loam, sandy clay loam.	SC, CL	A-4, A-6, A-7	0	100	100	80-100	40-85	30-50	8-25
	38-60	Clay loam, sandy clay loam, loam.	SC, CL, ML, SM	A-4, A-6	0	100	100	80-100	35-85	20-40	NP-15
De--------------- Detroit	0-14	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	20-30
	14-38	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	90-100	50-60	25-35
	38-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	95-100	85-100	25-45	10-25
Ed--------------- Edalgo	0-9	Clay loam--------	CL	A-6, A-7	0	95-100	85-100	75-100	60-95	30-45	10-25
	9-13	Silty clay loam, clay loam, sandy clay loam.	CL	A-6, A-7	0	95-100	85-100	75-100	65-95	25-45	10-25
	13-28	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	95-100	85-100	75-100	70-95	45-70	20-40
	28	Weathered bedrock	---	---	---	---	---	---	---	---	---
Ge, Gf----------- Geary	0-9	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	80-100	25-40	4-15
	9-42	Silty clay loam, clay loam.	CL	A-7, A-6	0	100	100	96-100	85-100	35-50	15-25
	42-60	Silty clay loam, clay loam, silt loam.	CL	A-6, A-7	0	100	100	96-100	85-100	30-45	11-22
Ho--------------- Hord	0-15	Silt loam--------	CL, ML, CL-ML	A-4, A-6	0	100	100	95-100	85-100	20-35	3-18
	15-31	Silt loam, silty clay loam, loam.	CL	A-6, A-4	0	100	100	98-100	85-100	25-40	8-23
	31-60	Silt loam, very fine sandy loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	100	100	100	85-100	25-40	6-21
Ir, Is----------- Irwin	0-11	Silty clay loam	CL, ML	A-6, A-7	0	100	95-100	90-100	80-95	35-50	10-25
	11-43	Silty clay, clay	CH	A-7	0	100	95-100	95-100	85-95	50-70	25-45
	43-60	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	100	100	95-100	80-95	40-65	20-45
Kc*: Kipson----------	0-7	Silt loam--------	CL-ML, CL	A-4, A-6	0-25	80-100	70-100	65-95	60-95	25-35	5-15
	7-18	Loam, silt loam, silty clay loam.	CL	A-6, A-4, A-7	0-25	80-100	75-100	70-100	50-95	25-45	10-22
	18	Weathered bedrock	---	---	---	---	---	---	---	---	---
Clime-----------	0-8	Silty clay loam	CL	A-6, A-7	0-5	90-100	90-100	85-100	80-95	40-50	20-25
	8-20	Silty clay, clay, silty clay loam.	CH, CL	A-7, A-6	0	95-100	95-100	95-100	85-95	45-65	20-40
	20-28	Silty clay, clay, silty clay loam.	CL, CH	A-7	0	95-100	95-100	95-100	85-95	45-60	20-30
	28	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
Lf---------------- Lancaster	0-9	Loam-------------	CL-ML, CL	A-4, A-6	0-5	95-100	90-100	85-100	60-90	20-35	5-15
	9-24	Sandy clay loam, clay loam, loam.	CL, SC	A-4, A-6, A-7	0	100	95-100	80-95	40-65	25-45	8-25
	24-30	Clay loam, loam, sandy clay loam.	CL-ML, SC, SM-SC, CL	A-4, A-6	0-10	95-100	90-100	80-100	36-80	20-35	5-15
	30	Weathered bedrock	---	---	---	---	---	---	---	---	---
Lh*:											
Lancaster--------	0-9	Loam-------------	CL-ML, CL	A-4, A-6	0-5	95-100	90-100	85-100	60-90	20-35	5-15
	9-24	Sandy clay loam, clay loam, loam.	CL, SC	A-4, A-6, A-7	0	100	95-100	80-95	40-65	25-45	8-25
	24-30	Clay loam, loam, sandy clay loam.	CL-ML, SC, SM-SC, CL	A-4, A-6	0-10	95-100	90-100	80-100	36-80	20-35	5-15
	30	Weathered bedrock	---	---	---	---	---	---	---	---	---
Hedville---------	0-8	Loam-------------	ML, CL, SM, SC	A-4, A-6	0-15	80-100	75-100	65-95	45-75	<35	NP-13
	8-17	Loam, gravelly loam, fine sandy loam.	SM, ML, SC, CL	A-4, A-6, A-2	0-15	60-90	50-85	30-80	15-60	<35	NP-13
	17	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Lm, Lo------------ Longford	0-11	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	95-100	90-100	75-95	25-40	5-20
	11-38	Silty clay loam, silty clay, clay loam.	CH, CL	A-7	0	100	95-100	90-100	85-100	40-60	20-35
	38-60	Clay loam, silty clay loam, loam.	CL	A-6, A-7	0	100	95-100	90-100	70-95	30-45	10-25
Mc---------------- McCook	0-11	Silt loam--------	ML, CL, CL-ML	A-4	0	100	100	95-100	60-100	20-35	2-10
	11-60	Very fine sandy loam, silt loam, loam.	ML, CL, CL-ML	A-4	0	100	100	95-100	80-100	<20	NP-10
Ne---------------- New Cambria	0-14	Silty clay-------	CH	A-7	0	100	100	95-100	90-100	50-75	30-45
	14-40	Silty clay, silty clay loam, clay.	CH	A-7	0	100	100	95-100	85-100	50-75	25-45
	40-60	Silty clay, silty clay loam, clay.	CH, CL	A-7	0	100	100	95-100	85-100	40-60	20-40
Ot---------------- Ortello	0-14	Fine sandy loam	SM, ML	A-4	0	100	100	70-95	40-55	<20	NP
	14-31	Fine sandy loam, sandy loam.	SM, ML	A-4	0	100	100	70-95	40-55	<20	NP
	31-60	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM	A-3, A-2	0	100	100	50-70	5-35	---	NP
Ov---------------- Orthents	0-10	Silty clay loam	CH, CL	A-7, A-6	0	100	100	95-100	90-100	35-55	15-30
	10-40	Clay loam, silty clay loam, silty clay.	CH, CL	A-6, A-7	0	100	95-100	95-100	80-100	35-60	15-40
	40-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	95-100	90-100	40-65	20-45
Ro---------------- Roxbury	0-26	Silt loam--------	CL	A-4, A-6	0	100	100	95-100	65-100	25-40	7-20
	26-60	Silt loam, silty clay loam, loam.	ML, CL	A-4, A-6, A-7	0	100	100	95-100	65-100	30-50	7-25

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Sm---------------- Smolan	0-6	Silt loam--------	CL	A-6, A-7	0	100	100	95-100	85-100	35-42	15-22
	6-18	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	85-100	35-50	15-28
	18-46	Silty clay loam, silty clay.	CH	A-7	0	100	100	95-100	90-100	50-65	28-40
	46-60	Silty clay loam	CL	A-7	0	100	100	95-100	90-100	42-50	22-28
So---------------- Solomon	0-16	Silty clay-------	CH	A-7	0	100	100	95-100	90-100	50-75	35-50
	16-60	Silty clay, clay	CH	A-7	0	100	100	95-100	90-100	50-75	25-50
St---------------- Sutphen	0-6	Silty clay-------	CH	A-7	0	100	100	95-100	90-100	50-70	25-40
	6-47	Clay, silty clay	CH	A-7	0	100	100	95-100	90-100	50-70	25-40
	47-60	Clay, silty clay, silty clay loam.	CH, CL	A-7	0	100	100	95-100	90-100	41-70	20-40
To---------------- Tobin	0-20	Silt loam--------	CL	A-4, A-6	0	100	100	95-100	90-100	25-35	8-15
	20-60	Silt loam, silty clay loam, loam.	CL	A-4, A-6, A-7	0	100	100	95-100	90-100	25-45	8-20
Wr, Ws------------ Wells	0-13	Loam-------------	CL-ML, CL	A-4, A-6	0	100	100	95-100	65-85	20-35	5-20
	13-38	Clay loam, sandy clay loam.	SC, CL	A-4, A-6, A-7	0	100	100	80-100	40-85	30-50	8-25
	38-60	Clay loam, sandy clay loam, loam.	SC, CL, ML, SM	A-4, A-6	0	100	100	80-100	35-85	20-40	NP-15

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Ba*:												
Bavaria	0-6	18-27	1.20-1.35	0.6-2.0	0.22-0.24	6.1-7.3	2-4	Low	0.43	3	6	1-3
	6-13	18-35	1.20-1.35	0.6-2.0	0.21-0.24	6.1-7.3	2-4	Moderate	0.37			
	13-35	35-45	1.30-1.40	0.06-0.2	0.08-0.14	7.4-9.0	4-16	High	0.37			
	35-45	18-35	1.30-1.50	0.2-0.6	0.10-0.16	7.4-9.0	2-4	Moderate	0.37			
	45-60	18-35	1.30-1.50	0.2-0.6	0.10-0.16	7.4-9.0	<2	Moderate	0.37			
Detroit	0-7	22-27	1.25-1.40	0.2-0.6	0.22-0.24	6.1-7.3	<2	Low	0.37	5	6	2-4
	7-38	35-45	1.35-1.50	0.06-0.2	0.12-0.18	6.6-7.8	<2	High	0.37			
	38-60	18-35	1.30-1.50	0.2-0.6	0.18-0.22	6.6-8.4	<2	Moderate	0.37			
Cd	0-13	7-17	1.40-1.60	2.0-6.0	0.16-0.18	5.6-7.3	<2	Low	0.20	5	3	1-2
Cass	13-60	5-15	1.40-1.60	2.0-6.0	0.15-0.17	6.1-8.4	<2	Low	0.20			
Ce	0-8	32-40	1.35-1.45	0.2-0.6	0.21-0.23	6.6-8.4	<2	Moderate	0.37	3	7	2-4
Clime	8-20	35-60	1.35-1.50	0.06-0.2	0.12-0.18	7.4-8.4	<2	Moderate	0.28			
	20-28	35-50	1.40-1.50	0.06-0.2	0.10-0.14	7.4-8.4	<2	Moderate	0.28			
	28	---	---	---	---	---	---	----------	----			
Co	0-14	11-25	1.30-1.40	0.6-2.0	0.20-0.22	6.1-7.3	<2	Low	0.32	5	6	1-2
Cozad	14-36	10-18	1.30-1.40	0.6-2.0	0.17-0.19	6.1-8.4	<2	Low	0.43			
	36-60	8-18	1.20-1.50	0.6-2.0	0.15-0.19	6.6-8.4	<2	Low	0.24			
Cr, Cs	0-10	20-27	1.20-1.40	0.6-2.0	0.22-0.24	5.6-6.0	<2	Moderate	0.37	4	6	2-4
Crete	10-16	27-35	1.20-1.40	0.2-0.6	0.21-0.23	5.6-6.0	<2	High	0.37			
	16-44	42-52	1.10-1.30	0.06-0.2	0.12-0.20	6.1-7.3	<2	High	0.37			
	44-60	25-40	1.20-1.40	0.2-2.0	0.18-0.22	7.4-8.4	<2	High	0.37			
Cx*:												
Crete	0-10	20-27	1.20-1.40	0.6-2.0	0.22-0.24	5.6-6.0	<2	Moderate	0.37	4	6	2-4
	10-16	27-35	1.20-1.40	0.2-0.6	0.21-0.23	5.6-6.0	<2	High	0.37			
	16-44	42-52	1.10-1.30	0.06-0.2	0.12-0.20	6.1-7.3	<2	High	0.37			
	44-60	25-40	1.20-1.40	0.2-2.0	0.18-0.22	7.4-8.4	<2	High	0.37			
Wells	0-13	18-27	1.35-1.50	0.6-2.0	0.20-0.22	5.6-6.5	<2	Low	0.28	5	6	1-4
	13-38	25-35	1.35-1.50	0.6-2.0	0.15-0.19	5.6-7.3	<2	Moderate	0.28			
	38-60	10-30	1.35-1.60	0.6-2.0	0.12-0.18	6.1-7.8	<2	Low	0.28			
De	0-14	28-35	1.25-1.40	0.2-0.6	0.21-0.23	6.1-7.3	<2	Moderate	0.37	5	7	2-4
Detroit	14-38	35-45	1.35-1.50	0.06-0.2	0.12-0.18	6.6-7.8	<2	High	0.37			
	38-60	18-35	1.30-1.50	0.2-0.6	0.18-0.22	6.6-8.4	<2	Moderate	0.37			
Ed	0-9	28-37	1.30-1.40	0.06-0.6	0.15-0.22	5.6-7.3	<2	Moderate	0.37	3	6	2-4
Edalgo	9-13	28-37	1.35-1.50	0.06-0.6	0.15-0.22	5.6-7.3	<2	Moderate	0.37			
	13-28	35-65	1.40-1.60	<0.06	0.10-0.18	6.6-8.4	<2	High	0.37			
	28	---	---	---	---	---	---	----------	----			
Ge, Gf	0-9	15-27	1.30-1.40	0.6-2.0	0.22-0.24	5.6-6.5	<2	Low	0.32	5	6	1-4
Geary	9-42	27-35	1.35-1.50	0.6-2.0	0.17-0.20	5.6-7.8	<2	Moderate	0.43			
	42-60	20-32	1.30-1.40	0.6-2.0	0.15-0.19	6.1-8.4	<2	Moderate	0.43			
Ho	0-15	17-27	1.30-1.40	0.6-2.0	0.20-0.24	5.6-7.3	<2	Low	0.32	5	6	2-4
Hord	15-31	20-35	1.35-1.45	0.6-2.0	0.17-0.22	6.1-7.8	<2	Low	0.32			
	31-60	18-30	1.30-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low	0.43			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Ir, Is----------- Irwin	0-11	28-35	1.35-1.45	0.2-0.6	0.18-0.23	5.6-7.3	<2	Moderate	0.37	4	7	2-4
	11-43	40-55	1.40-1.50	<0.06	0.10-0.15	5.6-8.4	<2	High------	0.37			
	43-60	35-55	1.40-1.50	<0.2	0.09-0.15	6.6-8.4	<2	High------	0.37			
Kc*: Kipson-----------	0-7	15-27	1.30-1.40	0.6-2.0	0.21-0.24	7.4-8.4	<2	Low--------	0.32	2	4L	---
	7-18	18-35	1.35-1.50	0.6-2.0	0.15-0.20	7.9-9.0	<2	Moderate	0.32			
	18	---	---	---	---	---	---	-----------	----			
Clime-----------	0-8	32-40	1.35-1.45	0.2-0.6	0.21-0.23	6.6-8.4	<2	Moderate	0.37	3	7	2-4
	8-20	35-60	1.35-1.50	0.06-0.2	0.12-0.18	7.4-8.4	<2	Moderate	0.28			
	20-28	35-50	1.40-1.50	0.06-0.2	0.10-0.14	7.4-8.4	<2	Moderate	0.28			
	28	---	---	---	---	---	---	-----------	----			
Lf--------------- Lancaster	0-9	12-26	1.35-1.45	0.6-2.0	0.17-0.22	5.6-6.5	<2	Low--------	0.28	4	6	1-4
	9-24	18-35	1.35-1.50	0.6-2.0	0.15-0.19	5.6-7.3	<2	Moderate	0.28			
	24-30	12-30	1.40-1.55	0.6-2.0	0.15-0.19	6.1-7.3	<2	Low--------	0.28			
	30	---	---	---	---	---	---	-----------	----			
Lh*: Lancaster--------	0-9	12-26	1.35-1.45	0.6-2.0	0.17-0.22	5.6-6.5	<2	Low--------	0.28	4	6	1-4
	9-24	18-35	1.35-1.50	0.6-2.0	0.15-0.19	5.6-7.3	<2	Moderate	0.28			
	24-30	12-30	1.40-1.55	0.6-2.0	0.15-0.19	6.1-7.3	<2	Low--------	0.28			
	30	---	---	---	---	---	---	-----------	----			
Hedville---------	0-8	8-22	1.35-1.50	0.6-2.0	0.18-0.20	5.6-7.3	<2	Low--------	0.32	2	5	1-4
	8-17	8-22	1.35-1.50	0.6-2.0	0.08-0.18	5.6-7.3	<2	Low--------	0.32			
	17	---	---	---	---	---	---	-----------	----			
Lm, Lo----------- Longford	0-11	15-27	1.30-1.40	0.6-2.0	0.20-0.24	5.6-7.3	<2	Low--------	0.32	5	6	1-4
	11-38	35-45	1.35-1.50	0.06-0.6	0.14-0.20	6.1-7.3	<2	High------	0.32			
	38-60	20-35	1.30-1.40	0.2-0.6	0.15-0.20	6.1-8.4	<2	Moderate	0.32			
Mc--------------- McCook	0-11	15-20	1.20-1.40	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low--------	0.32	5	4L	2-4
	11-60	10-18	1.30-1.45	0.6-2.0	0.17-0.20	7.4-8.4	<2	Low--------	0.43			
Ne--------------- New Cambria	0-14	40-60	1.30-1.40	0.06-0.2	0.12-0.14	6.6-8.4	<2	High------	0.28	5	4	2-4
	14-40	38-60	1.35-1.45	0.06-0.2	0.13-0.18	7.9-8.4	<2	High------	0.28			
	40-60	30-50	1.35-1.45	0.06-0.6	0.12-0.16	7.9-8.4	<2	High------	0.28			
Ot--------------- Ortello	0-14	5-15	1.40-1.60	2.0-6.0	0.13-0.18	6.1-7.3	<2	Low--------	0.20	5	3	1-2
	14-31	5-15	1.40-1.60	2.0-6.0	0.12-0.17	6.1-7.3	<2	Low--------	0.20			
	31-60	2-10	1.50-1.70	6.0-20	0.05-0.10	6.6-7.8	<2	Low--------	0.15			
Ov--------------- Orthents	0-10	27-50	1.35-1.45	0.2-0.6	0.09-0.12	5.6-7.8	<2	High------	0.32	3	4	<1
	10-40	35-50	1.35-1.50	0.06-0.2	0.10-0.14	5.6-7.8	<2	High------	0.32			
	40-60	35-60	1.35-1.45	0.06-0.2	0.09-0.12	5.6-7.8	<2	High------	0.32			
Ro--------------- Roxbury	0-26	18-27	1.30-1.45	0.6-2.0	0.22-0.24	7.4-8.4	<2	Low--------	0.32	5	4L	2-4
	26-60	18-35	1.35-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.43			
Sm--------------- Smolan	0-6	18-27	1.30-1.40	0.6-2.0	0.22-0.24	5.6-7.3	<2	Low--------	0.37	5	6	2-4
	6-18	18-35	1.30-1.40	0.2-0.2	0.21-0.24	5.6-7.3	<2	Moderate	0.37			
	18-46	35-50	1.30-1.45	0.06-0.2	0.12-0.18	5.6-7.8	<2	High------	0.37			
	46-60	27-35	1.30-1.40	0.2-0.6	0.18-0.20	6.6-7.8	<2	Moderate	0.37			
So--------------- Solomon	0-16	40-55	1.35-1.45	<0.06	0.11-0.15	7.4-8.4	<2	High------	0.28	5	4	2-4
	16-60	40-55	1.35-1.45	<0.06	0.09-0.14	7.9-9.0	<2	High------	0.28			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
St---------------- Sutphen	0-6	40-55	1.35-1.45	<0.06	0.11-0.14	6.1-8.4	<2	High------	0.28	5	4	2-4
	6-47	40-55	1.35-1.45	<0.06	0.10-0.14	6.6-8.4	<2	High------	0.28			
	47-60	35-55	1.35-1.45	<0.2	0.10-0.18	7.4-8.4	<2	High------	0.28			
To---------------- Tobin	0-20	18-27	1.30-1.40	0.6-2.0	0.20-0.24	5.6-7.8	<2	Moderate	0.32	5	6	1-4
	20-60	18-35	1.35-1.50	0.6-2.0	0.17-0.20	7.4-8.4	<2	Moderate	0.32			
Wr, Ws------------ Wells	0-13	18-27	1.35-1.50	0.6-2.0	0.20-0.22	5.6-6.5	<2	Low-------	0.28	5	6	1-4
	13-38	25-35	1.35-1.50	0.6-2.0	0.15-0.19	5.6-7.3	<2	Moderate	0.28			
	38-60	10-30	1.35-1.60	0.6-2.0	0.12-0.18	6.1-7.8	<2	Low-------	0.28			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," and "apparent" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Ba*:												
Bavaria	C	Rare	---	---	>6.0	---	---	>60	---	Low	High	High.
Detroit	C	Rare	---	---	>6.0	---	---	>60	---	Low	High	Low.
Cd Cass	B	Occasional	Very brief	Apr-Jun	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Ce Clime	C	None	---	---	>6.0	---	---	20-40	Soft	Moderate	High	Low.
Co Cozad	B	Rare	---	---	>6.0	---	---	>60	--	Moderate	Low	Low.
Cr, Cs Crete	C	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Cx*:												
Crete	C	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Wells	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Moderate.
De Detroit	C	Rare	---	--	>6.0	---	---	>60	---	Low	High	Low.
Ed Edalgo	C	None	---	---	>6.0	---	---	20-40	Soft	Moderate	Moderate	Low.
Ge, Gf Geary	B	None	---	---	>6.0	---	---	>60	---	High	Low	Low.
Ho Hord	B	Rare	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
Ir, Is Irwin	D	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
Kc*:												
Kipson	D	None	---	---	>6.0	---	---	7-20	Soft	Moderate	Low	Low.
Clime	C	None	---	---	>6.0	---	---	20-40	Soft	Moderate	High	Low.
Lf Lancaster	B	None	---	---	>6.0	---	---	20-40	Soft	Moderate	Low	Moderate.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
Lh*:												
Lancaster	B	None	---	---	>6.0	---	---	20-40	Soft	Moderate	Low	Moderate.
Hedville	D	None	---	---	>6.0	---	---	4-20	Hard	Moderate	Low	Moderate.
Lm, Lo: Longford	C	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
Mc: McCook	B	Rare	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
Ne: New Cambria	C	Rare	---	---	>6.0	---	---	>60	---	Low	High	Low.
Ot: Ortello	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Ov: Orthents	D	None	---	---	>6.0	---	---	>60	---	Low	High	Moderate.
Ro: Roxbury	B	Rare	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
Sm: Smolan	C	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
So: Solomon	D	Occasional	Brief to long.	Apr-Jun	0-2.0	Apparent	Dec-May	>60	---	High	High	Low.
St: Sutphen	D	Occasional	Very brief	Apr-Jun	>6.0	---	---	>60	---	Low	High	Low.
To: Tobin	B	Occasional	Very brief	Apr-Jun	>6.0	---	---	>60	---	Moderate	Low	Low.
Wr, Ws: Wells	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Moderate.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Bavaria	Fine, montmorillonitic, mesic Leptic Natrustolls
Cass	Coarse-loamy, mixed, mesic Fluventic Haplustolls
Clime	Fine, mixed, mesic Udorthentic Haplustolls
Cozad	Coarse-silty, mixed, mesic Fluventic Haplustolls
Crete	Fine, montmorillonitic, mesic Pachic Argiustolls
Detroit	Fine, montmorillonitic, mesic Pachic Argiustolls
Edalgo	Fine, mixed, mesic Udic Argiustolls
Geary	Fine-silty, mixed, mesic Udic Argiustolls
Hedville	Loamy, mixed, mesic Lithic Haplustolls
Hord	Fine-silty, mixed, mesic Cumulic Haplustolls
Irwin	Fine, mixed, mesic Pachic Argiustolls
Kipson	Loamy, mixed, mesic, shallow Udorthentic Haplustolls
Lancaster	Fine-loamy, mixed, mesic Udic Argiustolls
Longford	Fine, montmorillonitic, mesic Udic Argiustolls
McCook	Coarse-silty, mixed, mesic Fluventic Haplustolls
New Cambria	Fine, montmorillonitic, mesic Cumulic Haplustolls
Ortello	Coarse-loamy, mixed, mesic Udic Haplustolls
Orthents	Orthents
Roxbury	Fine-silty, mixed, mesic Cumulic Haplustolls
Smolan	Fine, montmorillonitic, mesic Pachic Argiustolls
Solomon	Fine, montmorillonitic (calcareous), mesic Vertic Haplaquolls
Sutphen	Fine, montmorillonitic, mesic Udertic Haplustolls
Tobin	Fine-silty, mixed, mesic Cumulic Haplustolls
Wells	Fine-loamy, mixed, mesic Udic Argiustolls

Interpretive Groups

INTERPRETIVE GROUPS

(Dashes indicate that the soil was not assigned to the interpretive group)

Map symbol	Map unit	Land capability*	Prime farmland*	Range site
Ba	Bavaria-Detroit complex	IIIs	No	
	Bavaria			Saline Lowland.
	Detroit			Loamy Terrace.
Cd	Cass fine sandy loam, occasionally flooded	IIw	Yes	Sandy Lowland.
Ce	Clime silty clay loam, 2 to 6 percent slopes	IVe	No	Limy Upland.
Co	Cozad silt loam	I	Yes	Loamy Terrace.
Cr	Crete silt loam, 0 to 2 percent slopes	IIs	Yes	Clay Upland.
Cs	Crete silt loam, 2 to 5 percent slopes	IIIe	Yes	Clay Upland.
Cx	Crete-Wells complex, 2 to 7 percent slopes	IIIe	Yes	
	Crete			Clay Upland.
	Wells			Loamy Upland.
De	Detroit silty clay loam	I	Yes	Loamy Terrace.
Ed	Edalgo clay loam, 3 to 7 percent slopes	IVe	No	Clay Upland.
Ge	Geary silt loam, 1 to 3 percent slopes	IIe	Yes	Loamy Upland.
Gf	Geary silt loam, 3 to 7 percent slopes	IIIe	Yes	Loamy Upland.
Ho	Hord silt loam	I	Yes	Loamy Terrace.
Ir	Irwin silty clay loam, 1 to 3 percent slopes	IIIe	Yes	Clay Upland.
Is	Irwin silty clay loam, 3 to 7 percent slopes	IVe	Yes	Clay Upland.
Kc	Kipson-Clime complex, 6 to 20 percent slopes	VIe	No	Limy Upland.
Lf	Lancaster loam, 3 to 7 percent slopes	IVe	Yes	Loamy Upland.
Lh	Lancaster-Hedville complex, 3 to 20 percent slopes	VIe	No	
	Lancaster			Loamy Upland.
	Hedville			Shallow Sandstone.
Lm	Longford silt loam, 1 to 3 percent slopes	IIe	Yes	Loamy Upland.
Lo	Longford silt loam, 3 to 7 percent slopes	IIIe	Yes	Loamy Upland.
Mc	McCook silt loam	I	Yes	Loamy Terrace.
Ne	New Cambria silty clay	IIs	Yes	Clay Terrace.
Ot	Ortello fine sandy loam, 2 to 6 percent slopes	IIIe	Yes	Sandy.
Ov	Orthents, clayey	---	No	---
Ro	Roxbury silt loam	I	Yes	Loamy Terrace.
Sm	Smolan silt loam, 0 to 2 percent slopes	I	Yes	Loamy Upland.
So	Solomon silty clay, occasionally flooded	IIIw	No	Clay Lowland.
St	Sutphen silty clay, occasionally flooded	IIw	Yes	Clay Lowland.
To	Tobin silt loam, occasionally flooded	IIw	Yes	Loamy Lowland.
Wr	Wells loam, 1 to 3 percent slopes	IIe	Yes	Loamy Upland.
Ws	Wells loam, 3 to 7 percent slopes	IIIe	Yes	Loamy Upland.

* A complex is treated as a single management unit in the land capability classification and prime farmland columns.

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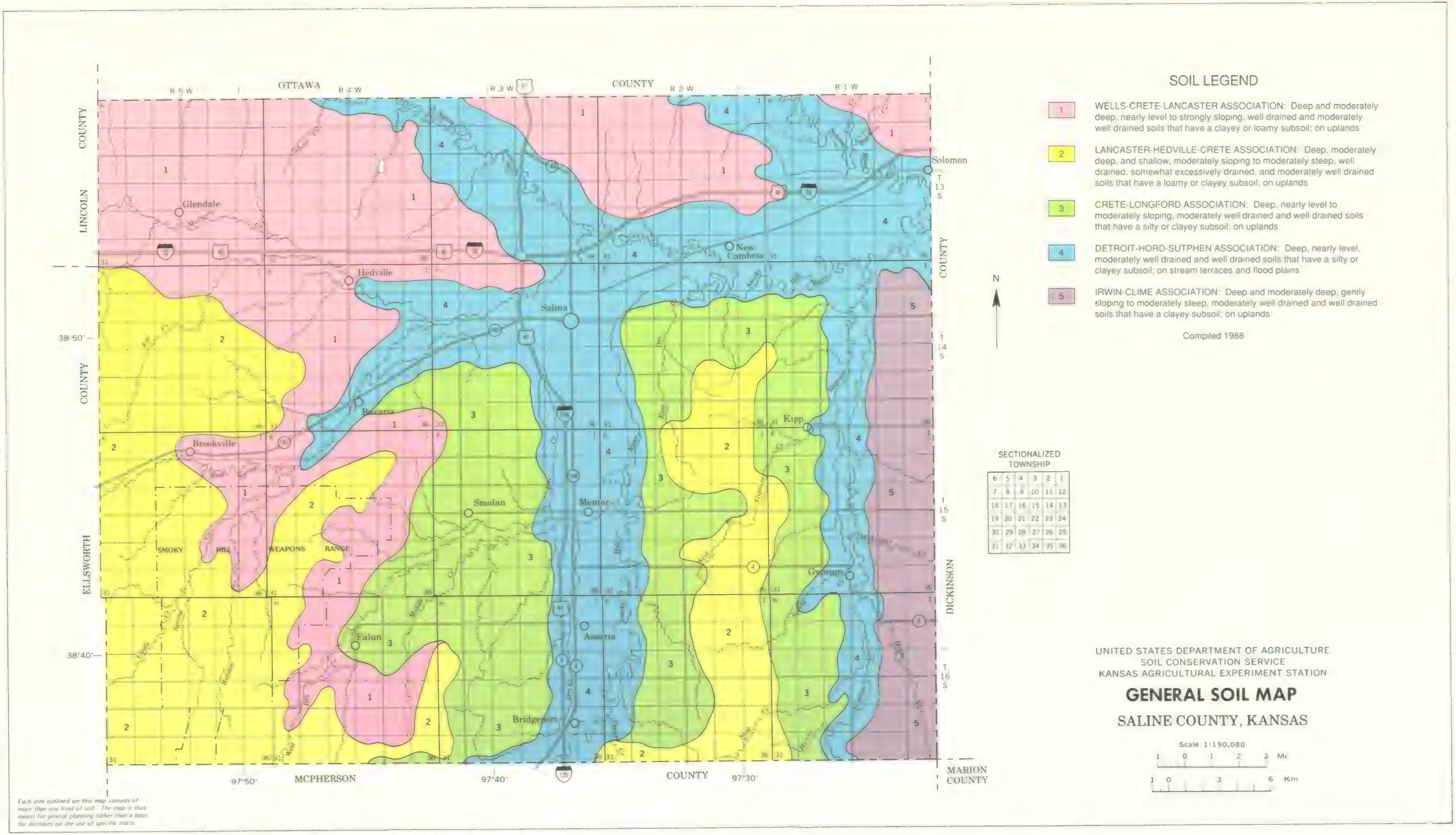
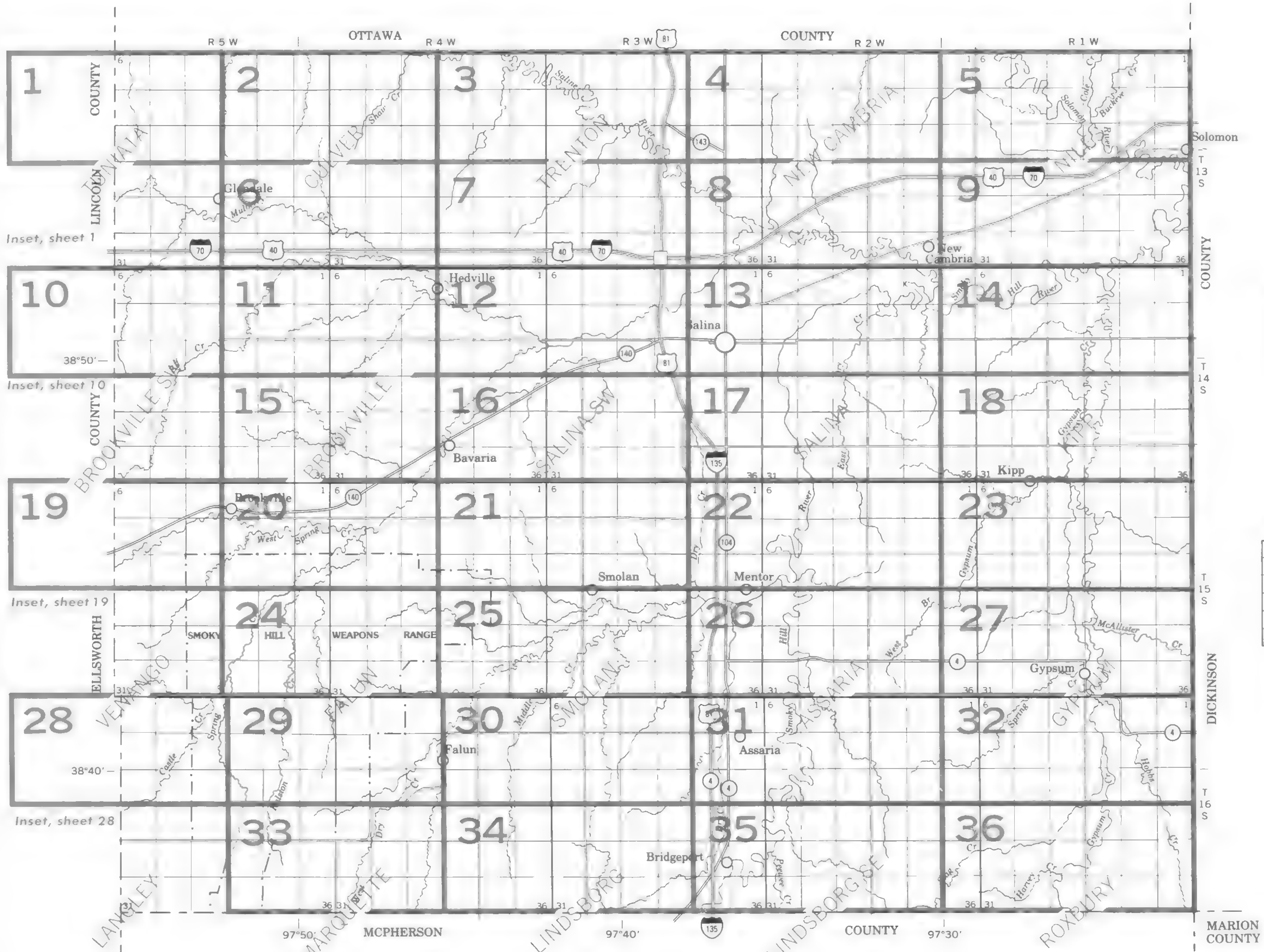

SOIL LEGEND
1 WELLS-CRETE-LANCASTER ASSOCIATION: Deep and moderately deep, nearly level to strongly sloping, well drained and moderately well drained soils that have a clayey or loamy subsoil; on uplands
2 LANCASTER-HEDVILLE-CRETE ASSOCIATION: Deep, moderately deep, and shallow, moderately sloping to moderately steep, well drained, somewhat excessively drained, and moderately well drained soils that have a loamy or clayey subsoil; on uplands
3 CRETE-LONGFORD ASSOCIATION: Deep, nearly level to moderately sloping, moderately well drained and well drained soils that have a silty or clayey subsoil; on uplands
4 DETROIT-HORD-SUTPHEN ASSOCIATION: Deep, nearly level, moderately well drained and well drained soils that have a silty or clayey subsoil; on stream terraces and flood plains
5 IRWIN-CLIME ASSOCIATION: Deep and moderately deep, gently sloping to moderately steep, moderately well drained and well drained soils that have a clayey subsoil; on uplands
Compiled 1988
N
SECTIONALIZED TOWNSHIP
UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
KANSAS AGRICULTURAL EXPERIMENT STATION
GENERAL SOIL MAP
SALINE COUNTY, KANSAS
Scale 1:190,080
Mi
Km
OTTAWA COUNTY
LINCOLN COUNTY
ELLSWORTH COUNTY
DICKINSON COUNTY
MCPHERSON COUNTY
MARION COUNTY
R 5 W
R 4 W
R 3 W
R 2 W
R 1 W
T 13 S
T 14 S
T 15 S
T 16 S
38°50'
38°40'
97°50'
97°40'
97°30'
Glendale
Hedville
Salina
New Cambria
Solomon
Bavaria
Brookville
Smolan
Mentor
Kipp
Gypsum
Falun
Assaria
Bridgeport
SMOKY HILL WEAPONS RANGE
Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



Original text from each individual map sheet read:
This soil survey map was compiled by the U. S. Department of Agriculture, Soil Conservation Service, and cooperating agencies.
Base maps are from 1981 aerial photography. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

INDEX TO MAP SHEETS
SALINE COUNTY, KANSAS

Scale 1:190,080

1 0 1 2 3 Mi

1 0 3 6 Km

SOIL LEGEND

SYMBOL	NAME
Ba	Bavaria-Detroit complex
Cd	Cass fine sandy loam, occasionally flooded
Ce	Clime silty clay loam, 2 to 6 percent slopes
Co	Cozad silt loam
Cr	Crete silt loam, 0 to 2 percent slopes
Cs	Crete silt loam, 2 to 5 percent slopes
Cx	Crete-Wells complex, 2 to 7 percent slopes
De	Detroit silty clay loam
Ed	Edalgo clay loam, 3 to 7 percent slopes
Ge	Geary silt loam, 1 to 3 percent slopes
Gf	Geary silt loam, 3 to 7 percent slopes
Ho	Hord silt loam
Ir	Irwin silty clay loam, 1 to 3 percent slopes
Is	Irwin silty clay loam, 3 to 7 percent slopes
Kc	Kipson-Clime complex, 6 to 20 percent slopes
Lf	Lancaster loam, 3 to 7 percent slopes
Lh	Lancaster-Hedville complex, 3 to 20 percent slopes
Lm	Longford silt loam, 1 to 3 percent slopes
Lo	Longford silt loam, 3 to 7 percent slopes
[illegible]	McCook silt loam
[illegible]	New Cambria silty clay
Ot	Ortello fine sandy loam, 2 to 6 percent slopes
Ov	Orthents, clayey
[illegible]	Roxbury silt loam
Sm	Smolan silt loam, 0 to 2 percent slopes
So	Solomon silty clay, occasionally flooded
St	Sutphen silty clay, occasionally flooded
To	Tobin silt loam, occasionally flooded
Wr	Wells loam, 1 to 3 percent slopes
Ws	Wells loam, 3 to 7 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state, or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline and neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool

STATE COORDINATE TICK
890000 FEET

LAND DIVISION CORNER
(sections and land grants)

ROADS

- Divided (median shown if scale permits)
- County, farm or ranch
- Trail

ROAD EMBLEM & DESIGNATIONS

- Interstate I-70
- Federal US-81
- State K-140

RAILROAD (label only)

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or Small

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban area)
- Church
- School
- Indian mound (label)
- Located object (label) Tower
- Tank (label) Gas
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) CANAL
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial
- Intermittent

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS Ba Cd

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

SOIL SAMPLE (normally not shown)

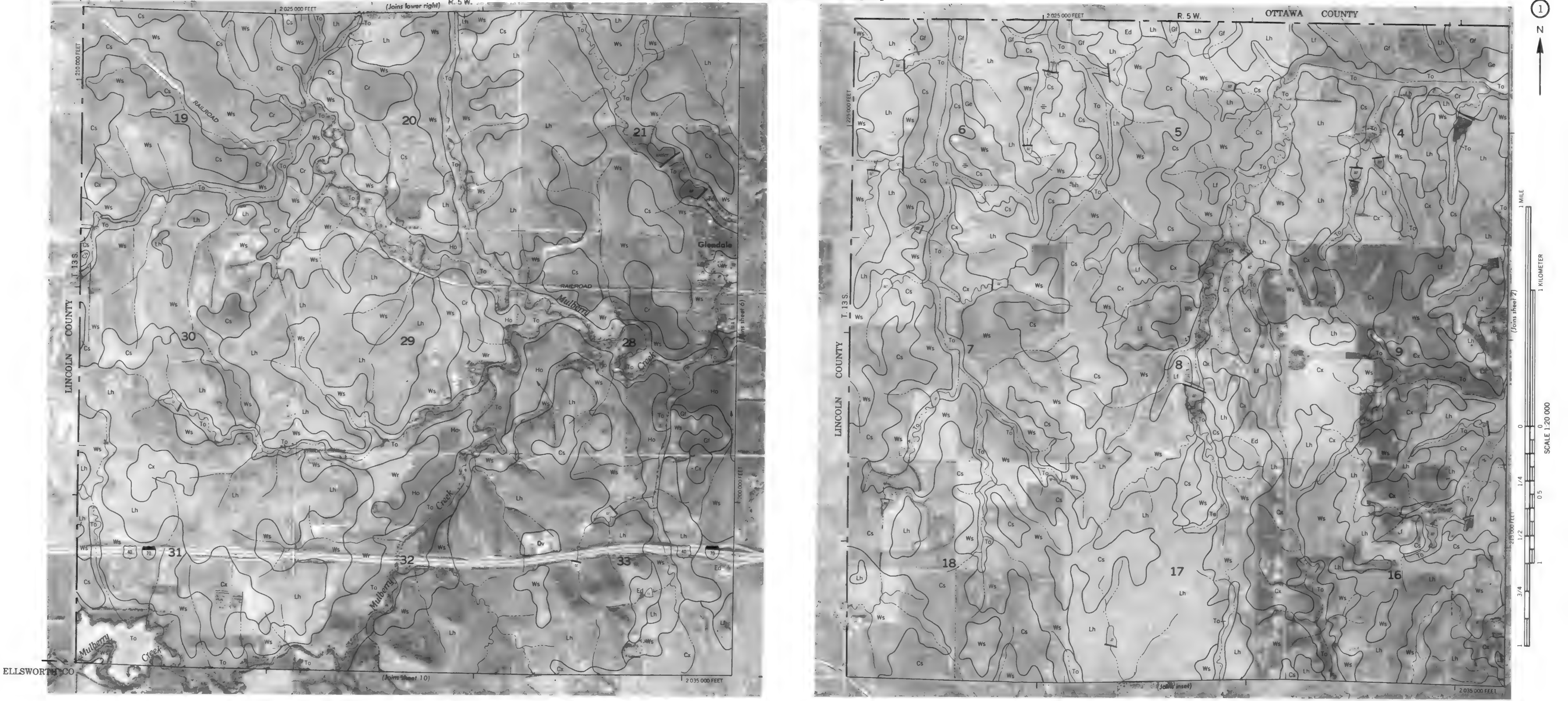
MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot

RECOMMENDED AD HOC SOIL SYMBOLS

- Borrow Area

SOIL SURVEY OF SALINE COUNTY, KANSAS — SHEET NUMBER 1



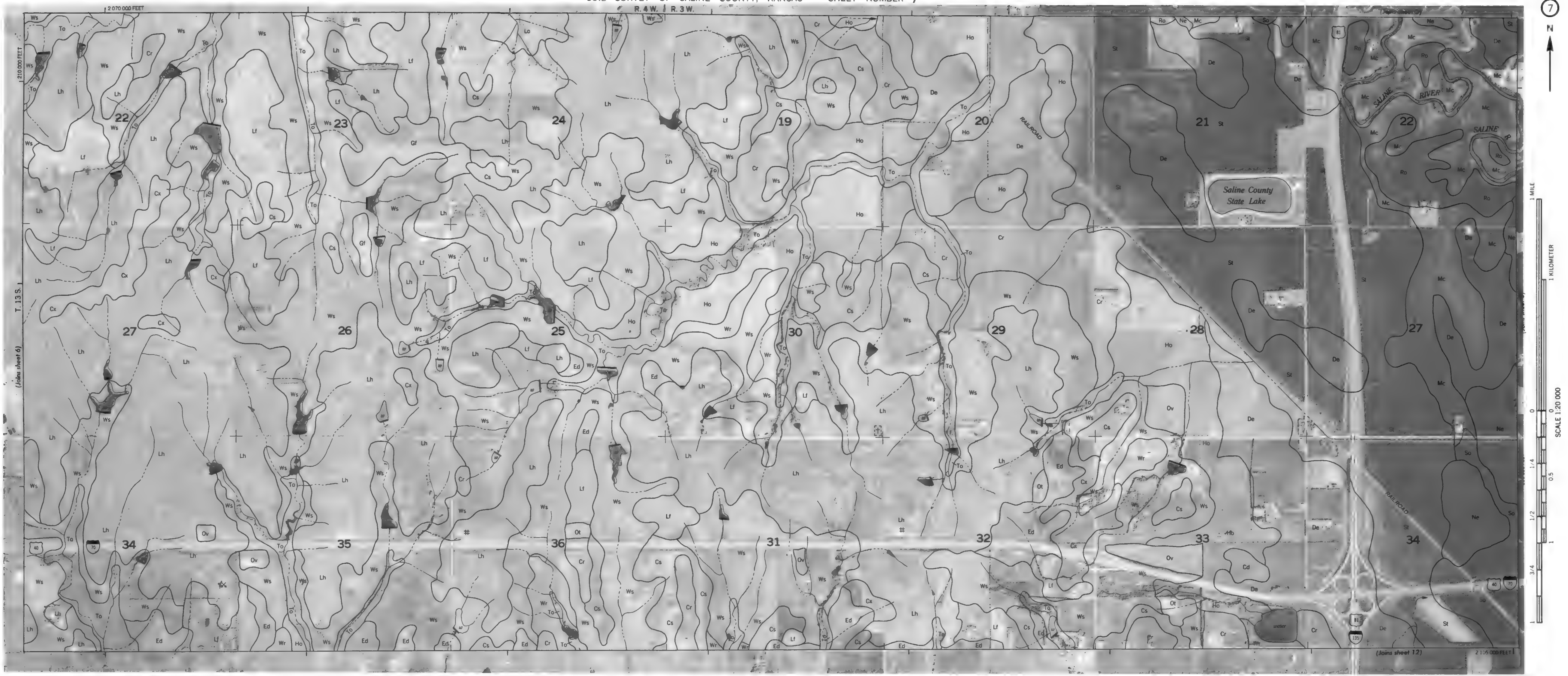
SOIL SURVEY OF SALINE COUNTY, KANSAS — SHEET NUMBER 2

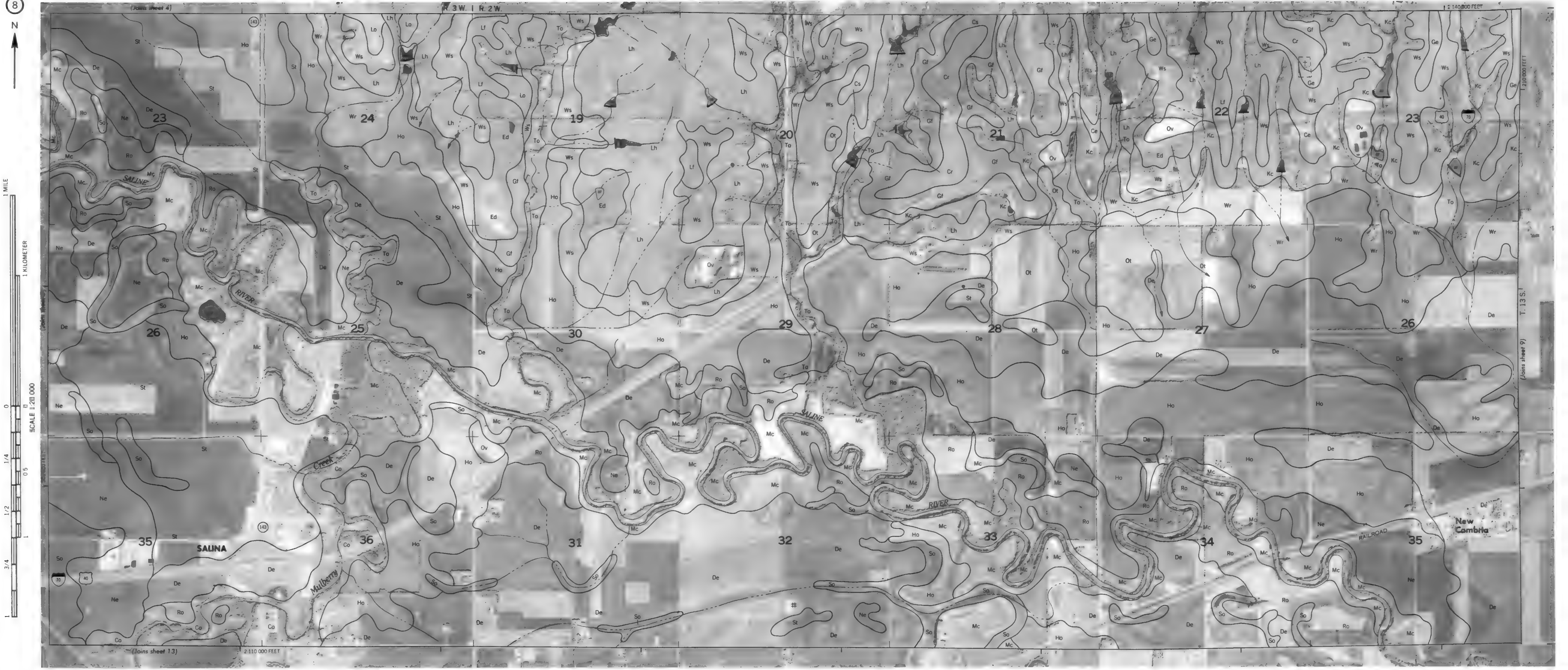
3
N
OTTAWA COUNTY
R. 4 W. | R. 3 W.
SALINE RIVER
RAILROAD
Wary Lake
(Joins sheet 2)
(Joins sheet 4)
(Joins sheet 7)
T. 13 S.
1 MILE
1 KILOMETER
SCALE 1:20 000


4
N
OTTAWA COUNTY
R. 3 W. | R. 2 W.
T. 13 S.
North Pole Mound
(Joins sheet 3)
(Joins sheet 5)
(Joins sheet 8)
2 110 000 FEET
2 140 000 FEET
215 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000


OTTAWA COUNTY
DICKINSON COUNTY
SOLOMON RIVER
Cole Creek
Buckeye Creek
RAILROAD
(Joins sheet 4)
(Joins sheet 9)
T. 13 S.
R. 2 W.
N
5
SCALE 1:20 000
1 MILE
1 KILOMETER

6
N
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 2)
R. 5 W.
R. 4 W.
2 060 000 FEET
210 000 FEET
200 000 FEET
T. 13 S.
(Joins sheet 7)
(Joins sheet 11)
2 040 000 FEET
(Joins sheet 1)
RAILROAD
Mulberry
Creek
Eff
Creek
22
23
24
19
20
21
27
26
25
30
29
28
34
35
36
31
32
33
Cx
Ed
Lh
Lf
Lo
Lm
To
Ws
Wr
Ho
Ot
Cs
De
Cd
Co
Ov


7
2 070 000 FEET
210 000 FEET
R. 4 W.
R. 3 W.
T. 13 S.
(Joins sheet 6)
(Joins sheet 12)
2 105 000 FEET
Saline County State Lake
SALINE RIVER
SALINE R.
RAILROAD
water
N
1 MILE
1 KILOMETER
SCALE 1:20 000
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36


8
N
(Joins sheet 4)
R. 3 W. | R. 2 W.
2 140 000 FEET
210 000 FEET
T. 13 S.
(Joins sheet 9)
(Joins sheet 13)
2 110 000 FEET
SALINE RIVER
Mulberry Creek
RAILROAD
SALINA
New Cambria
1 MILE
1 KILOMETER
SCALE 1:20 000
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36


9
N
(Joins sheet 5)
(Joins sheet 8)
(Joins sheet 14)
R. 2 W.
R. 1 W.
T. 13 S.
2 145 000 FEET
2 175 000 FEET
210 000 FEET
200 000 FEET
RAILROAD
SOLOMON RIVER
SMOKY HILL RIVER
DICKINSON COUNTY
1 MILE
1 KILOMETER
SCALE 1:20 000
24
19
20
21
22
23
25
30
29
28
27
26
36
31
32
33
34
35

(10)

N

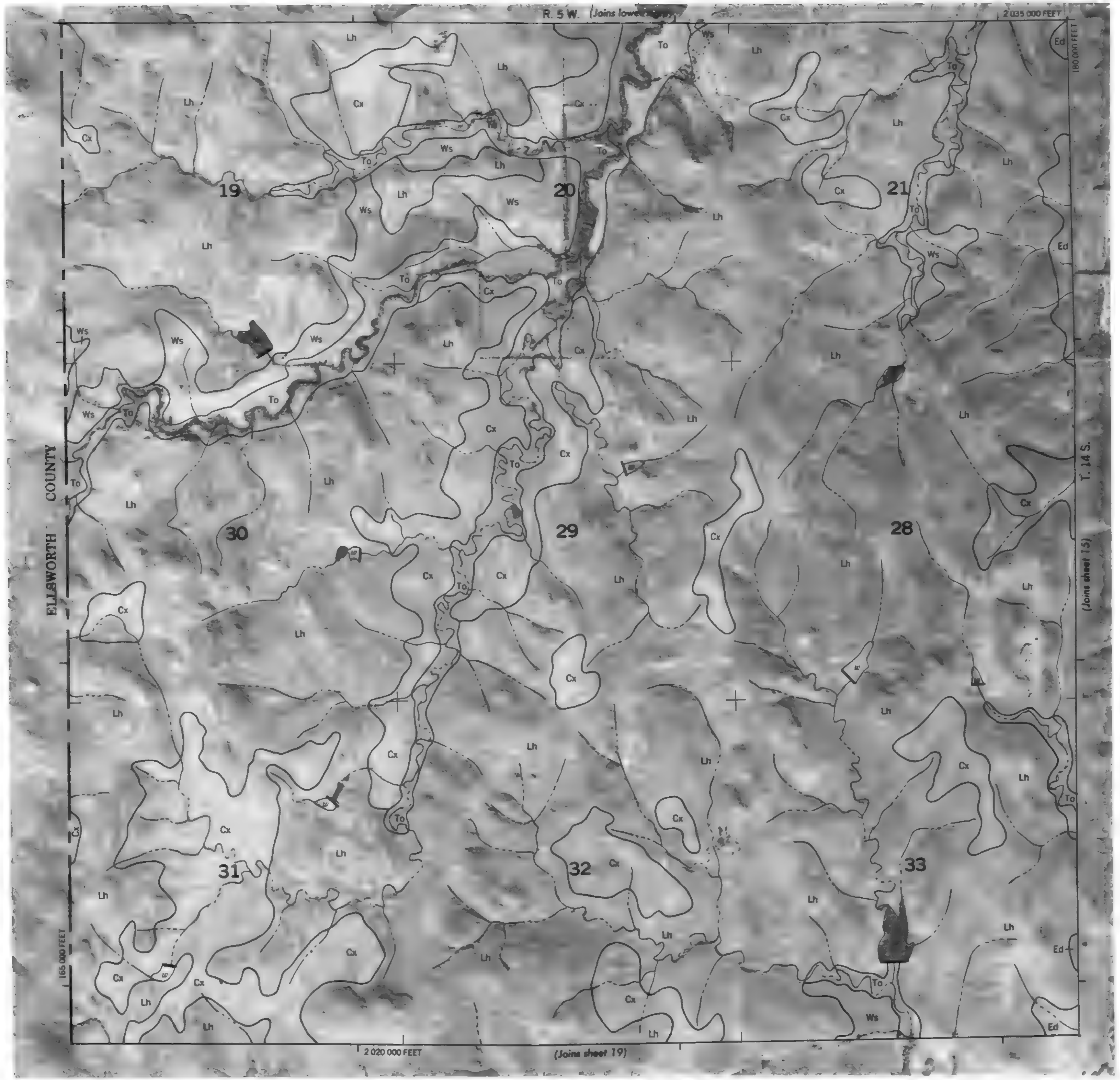
1 MILE

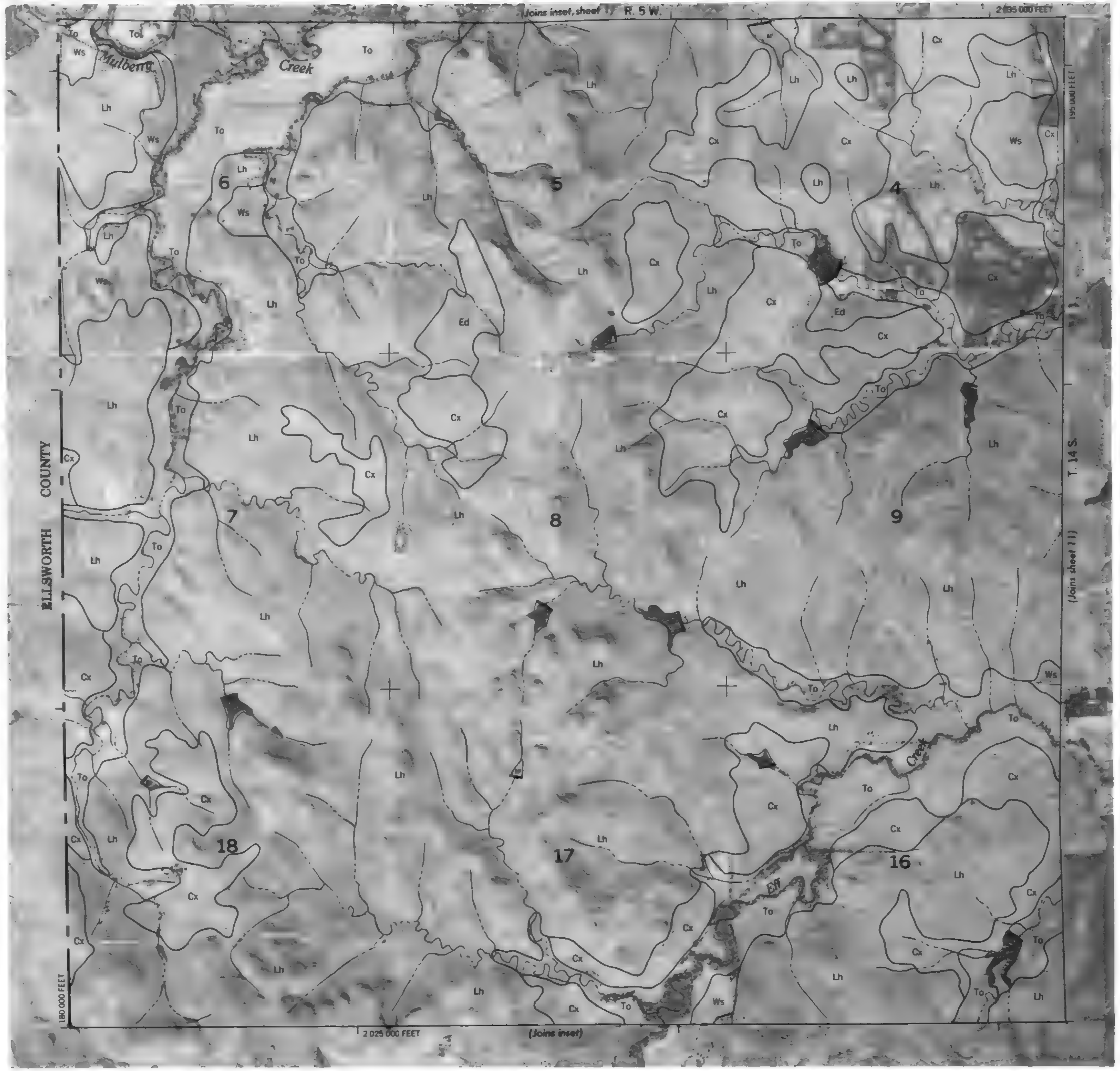
1 KILOMETER

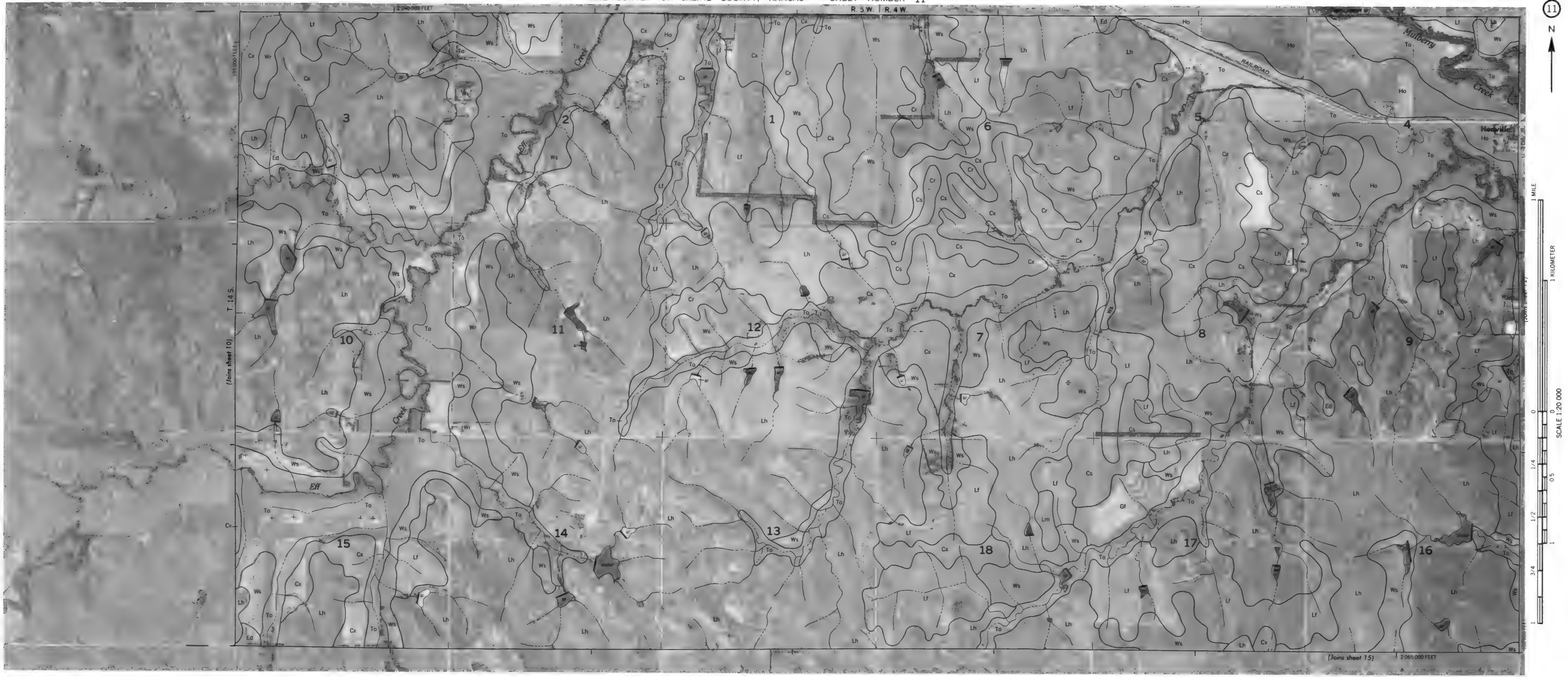
SCALE 1:20 000

0 1/4 1/2 3/4 1

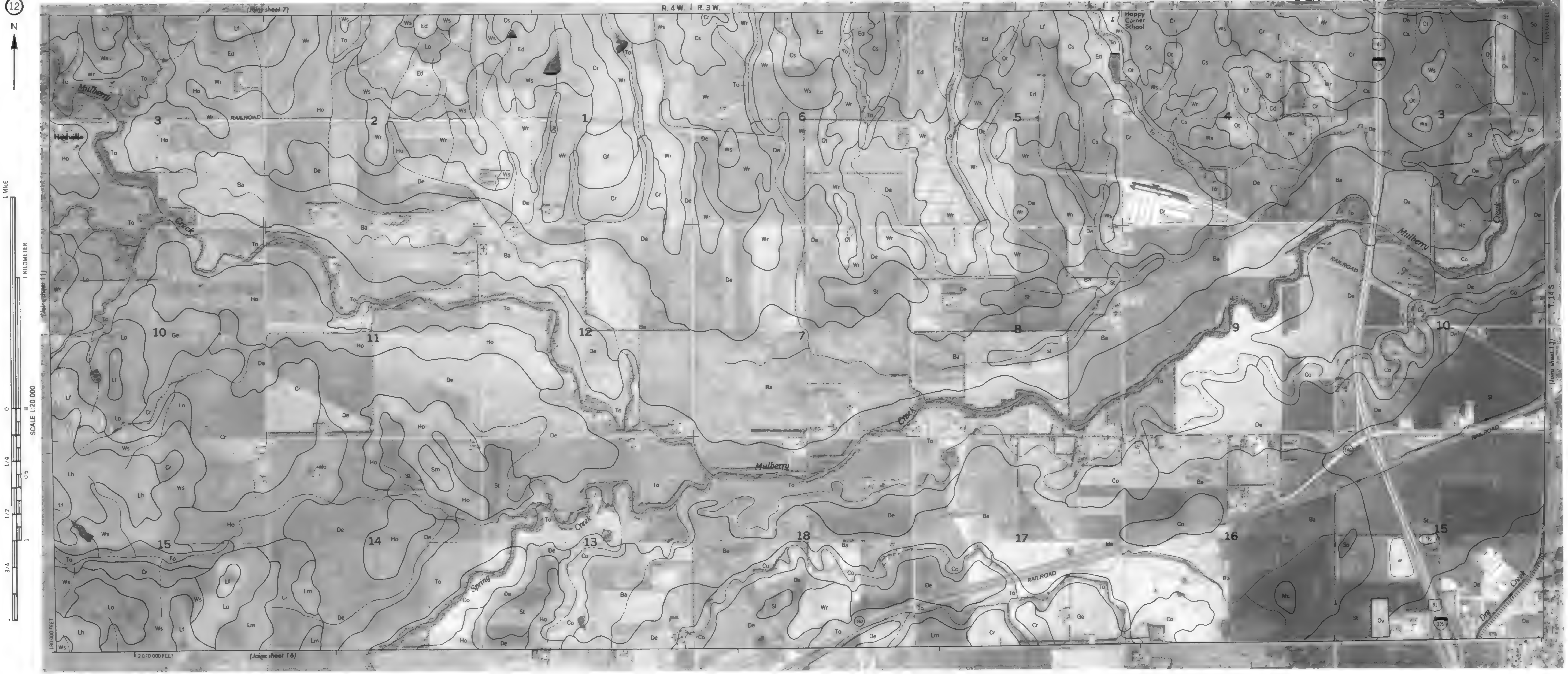
0 0.5 1



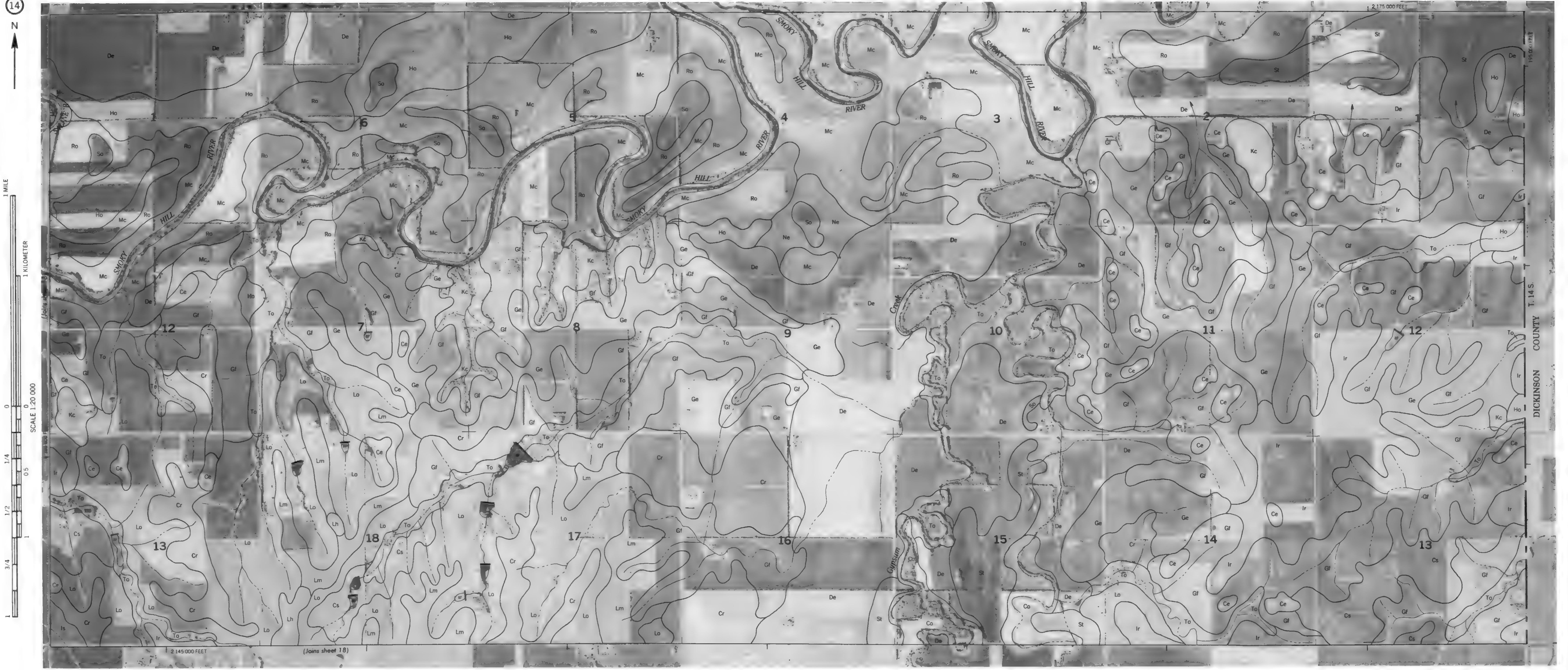



11
N
R. 5 W. | R. 4 W.
T. 14 S.
2 040 000 FEET
195 000 FEET
2 065 000 FEET
(Joins sheet 10)
(Joins sheet 15)
Mulberry Creek
RAILROAD
Hedville
Eff Creek
Eff
Creek
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0
0.5
1

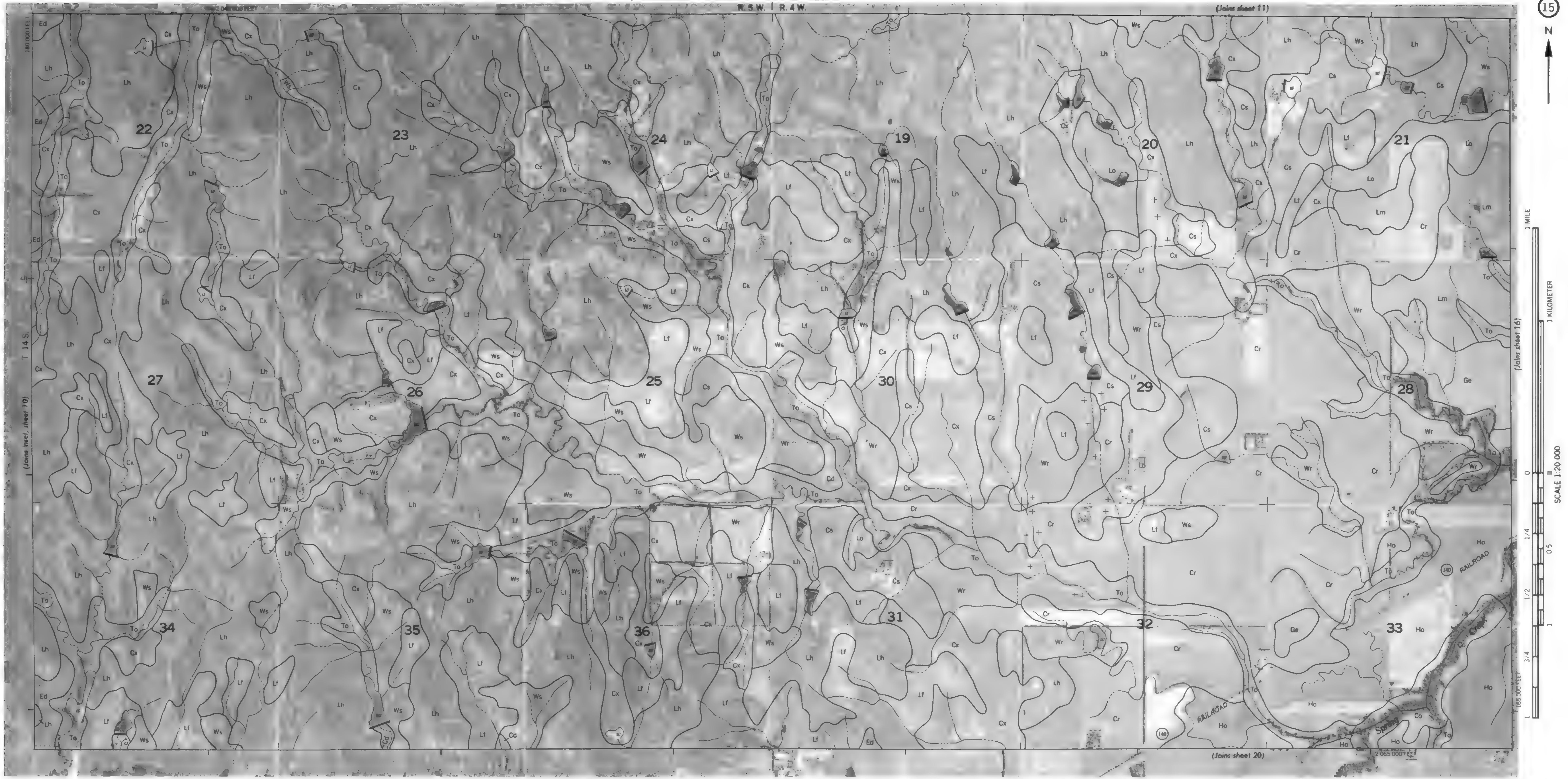
SOIL SURVEY OF SALINE COUNTY, KANSAS — SHEET NUMBER 12




13
N
R. 3 W.
R. 2 W.
(Joins sheet 8)
(Joins sheet 12)
(Joins sheet 17)
T. 14 S.
2 110 000 FEET
2 140 000 FEET
SALINA
(county seat)
SEWAGE LAGOON
SMOKY HILL RIVER
SALINE RIVER
Mulberry Creek
Dry Creek
RAILROAD
1 MILE
1 KILOMETER
SCALE 1:20 000


14
N
1 MILE
1 KILOMETER
SCALE 1:20 000
SMOKY HILL RIVER
SMOKY HILL RIVER
SMOKY HILL RIVER
Gypsum Creek
DICKINSON COUNTY
T. 14 S.
2 175 000 FEET
2 145 000 FEET
(Joins sheet 18)

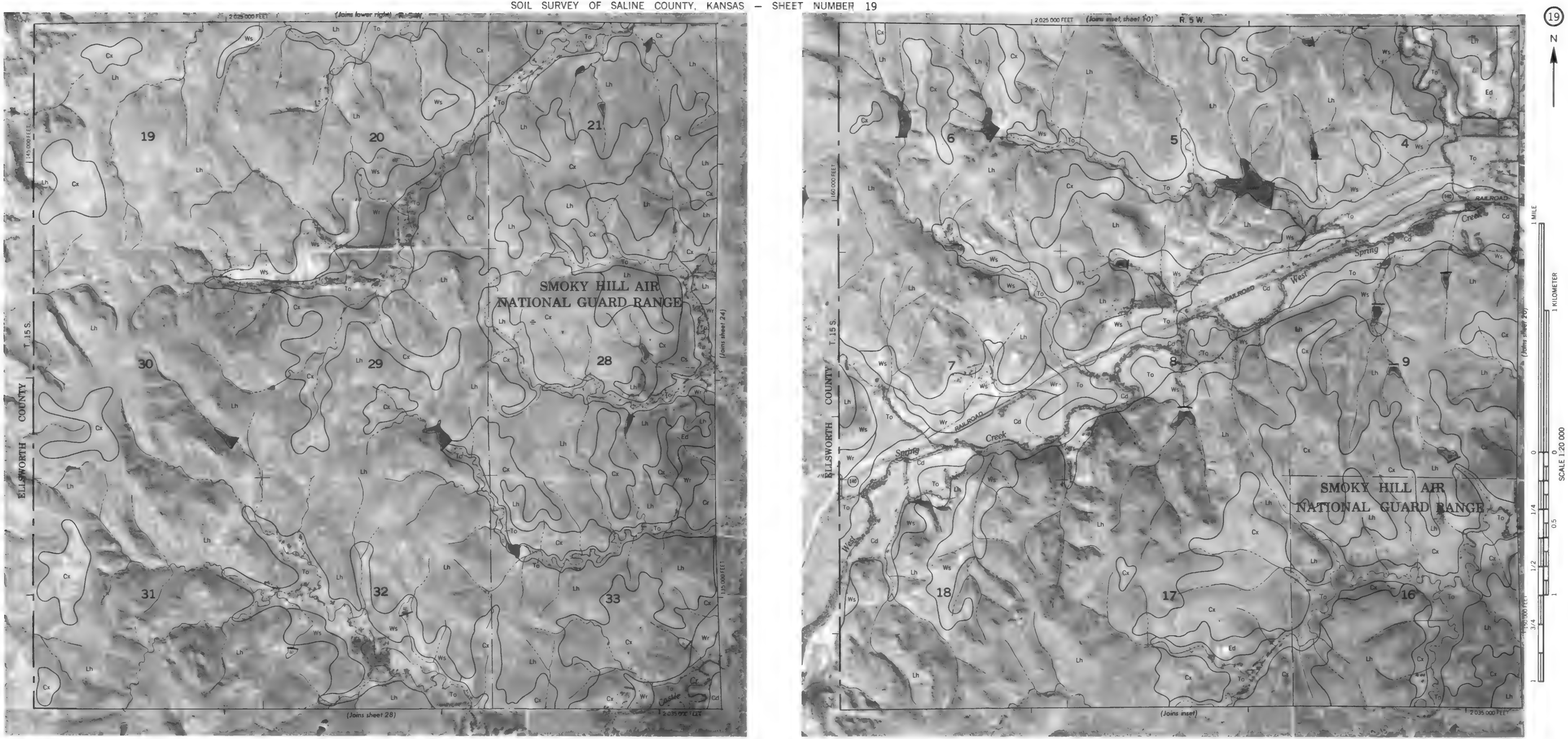
SOIL SURVEY OF SALINE COUNTY, KANSAS — SHEET NUMBER 15

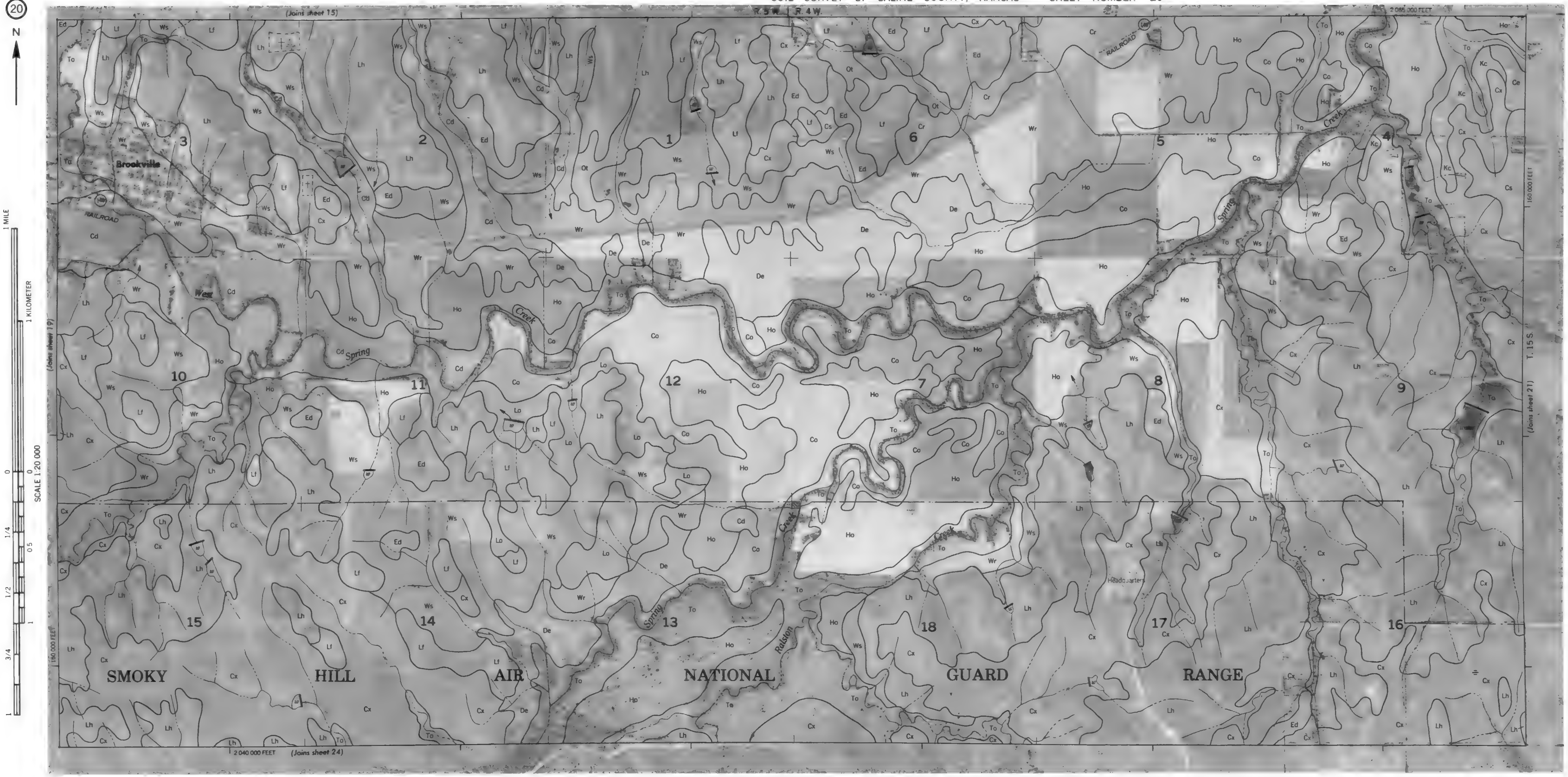


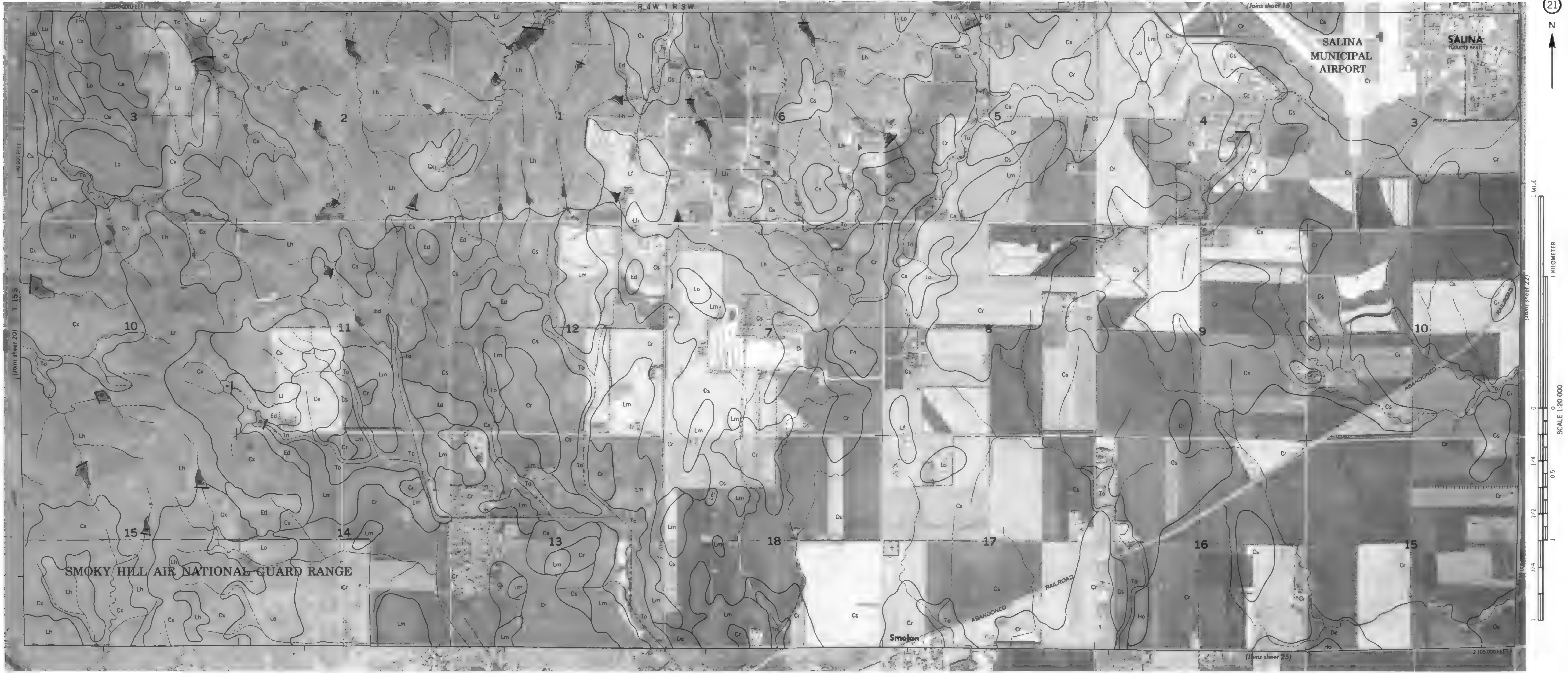

16
N
R. 4 W.
R. 3 W.
(Joins sheet 12)
(Joins sheet 21)
(Joins sheet 15)
(Joins sheet 17)
2 070 000 FEET
2 105 000 FEET
SALINA
(county seat)
SALINA MUNICIPAL AIRPORT
Bavaria
RAILROAD
Spring Creek
Dry Creek
SCALE 1:20 000
1 MILE
1 KILOMETER
22
23
24
19
20
21
22
27
26
25
30
29
28
27
34
35
36
31
32
33
34


17
N
(Joins sheet 13)
(Joins sheet 22)
(Joins sheet 16)
(Joins sheet 18)
SALINA
(county seat)
SMOKY
RIVER
Creek
East
Iron Mound
RAILROAD
T. 14 S.
R. 2 W.
1 MILE
1 KILOMETER
SCALE 1:20 000
2 140 000 FEET
180 000 FEET


18
N
R. 2 W. | R. 1 W. (Joins sheet 14)
(Joins sheet 17)
(Joins sheet 23)
DICKINSON COUNTY
14 S.
RAILROAD
Gypsum Creek
West Branch Gypsum
Kipp
1 MILE
1 KILOMETER
SCALE 1:20 000
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36

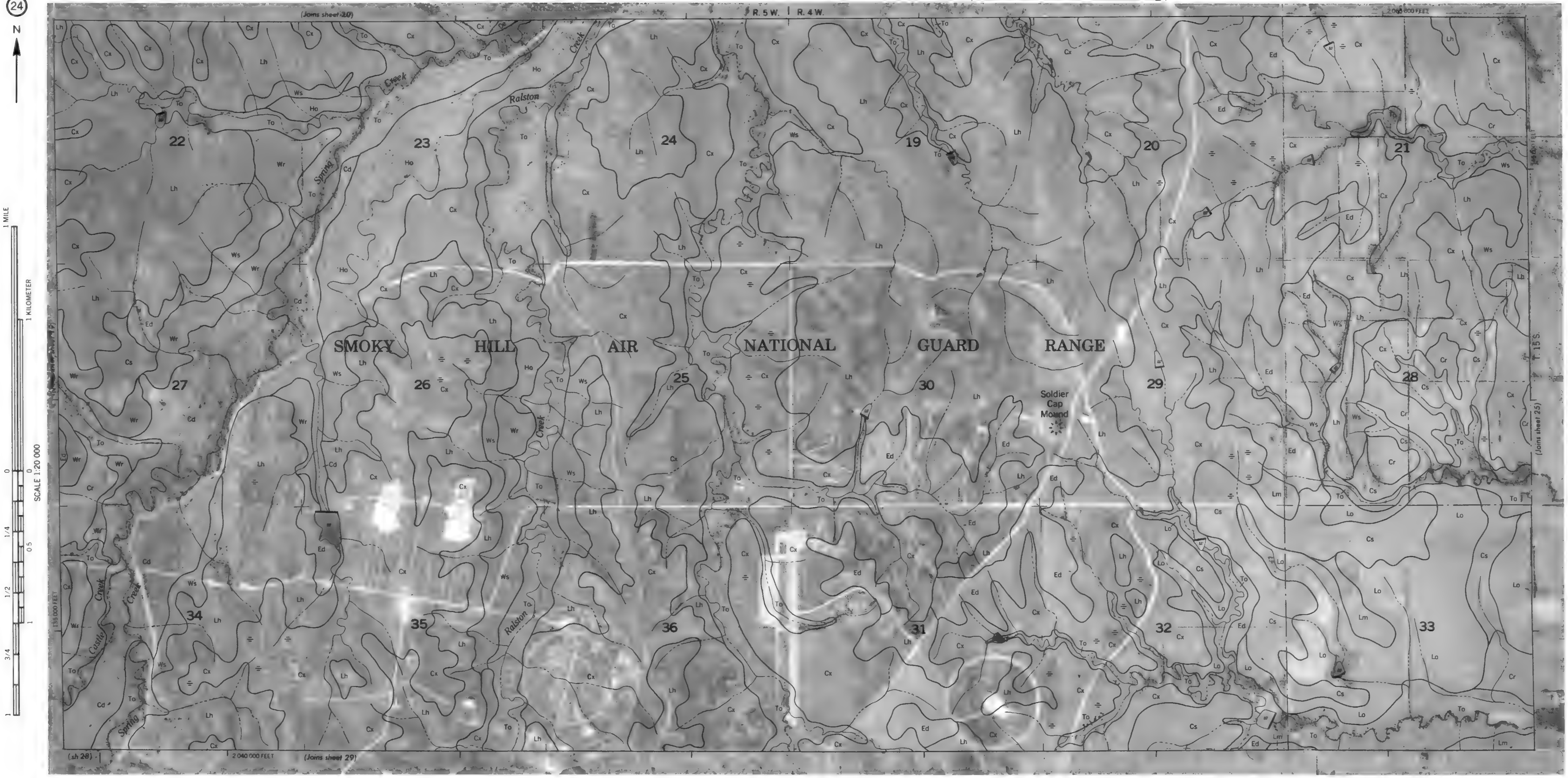

19
SMOKY HILL AIR NATIONAL GUARD RANGE
ELLSWORTH COUNTY
T. 15 S.
R. 5 W.
(Joins inset, sheet 10)
(Joins sheet 24)
(Joins sheet 28)
(Joins inset)
(Joins sheet 20)
West Spring Creek
RAILROAD
Castle Cr.
140
N
SCALE 1:20 000
1 MILE
1 KILOMETER

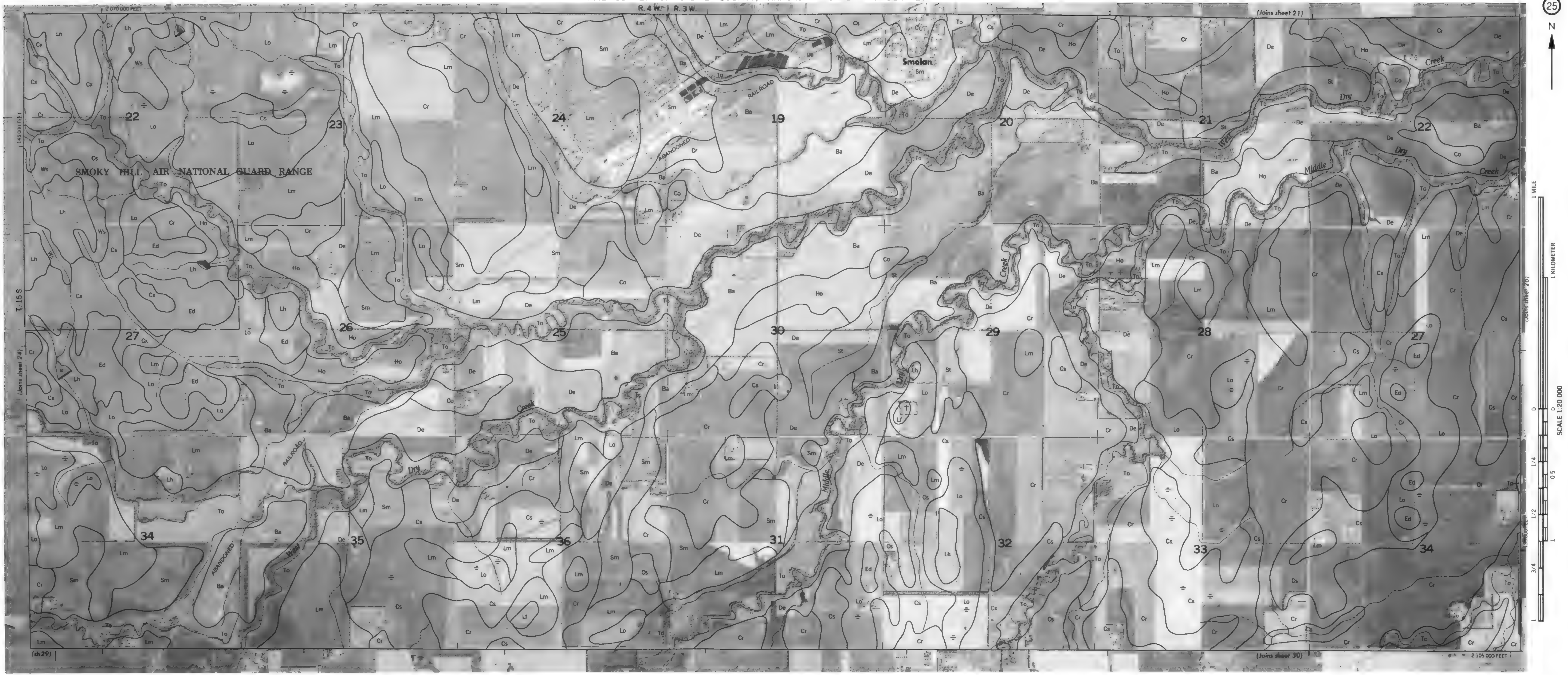

20
N
(Joins sheet 15)
R.5 W.
R.4 W.
2 065 000 FEET
Brookville
RAILROAD
West Creek
Spring Creek
Ralston Creek
Headquarters
SMOKY HILL AIR NATIONAL GUARD RANGE
(Joins sheet 19)
(Joins sheet 21)
(Joins sheet 24)
2 040 000 FEET
160 000 FEET
T.15 S.
1 MILE
1 KILOMETER
SCALE 1:20 000

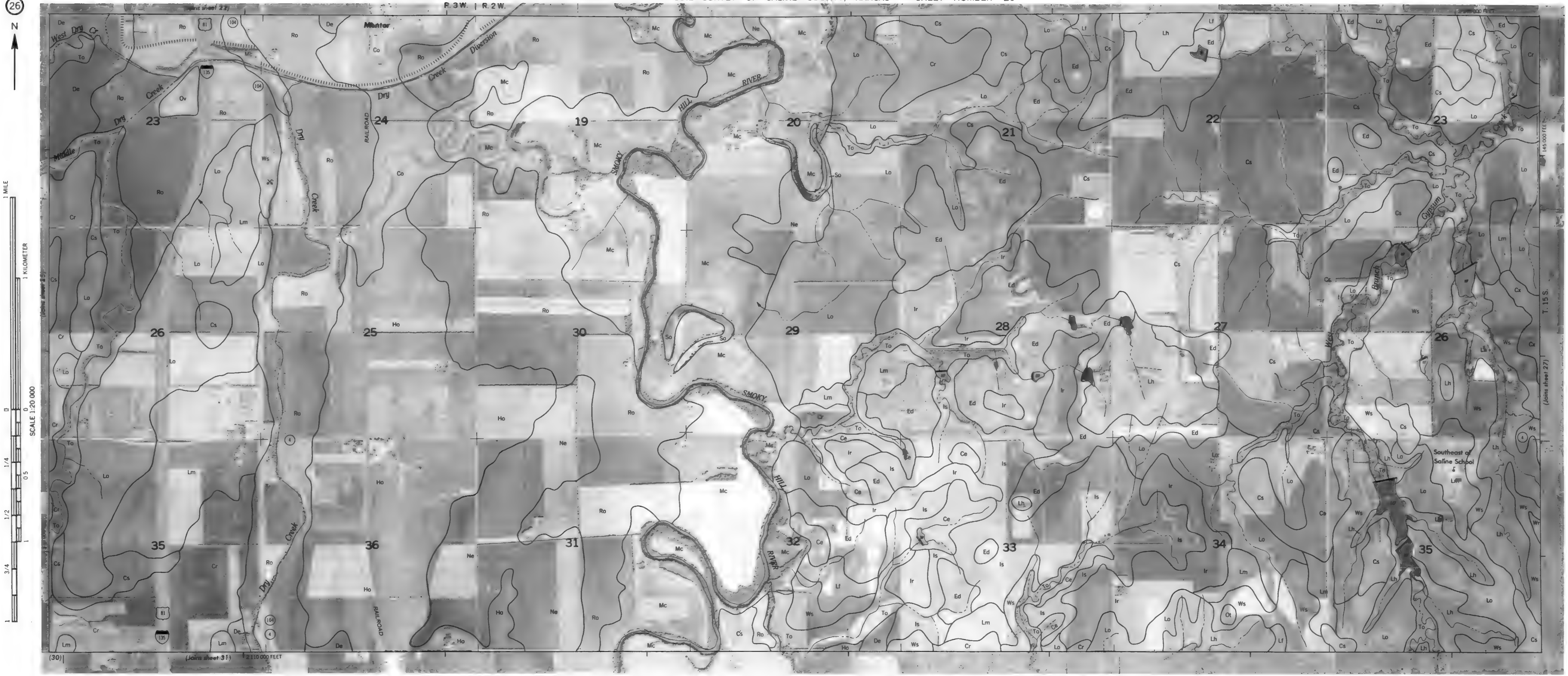

21
N
(Joins sheet 16)
R. 4 W. | R. 3 W.
SALINA MUNICIPAL AIRPORT
SALINA
(County seat)
T. 15 S.
(Joins sheet 20)
(Joins sheet 22)
SMOKY HILL AIR NATIONAL GUARD RANGE
ABANDONED RAILROAD
Smolan
(Joins sheet 25)
1 MILE
1 KILOMETER
SCALE 1:20 000

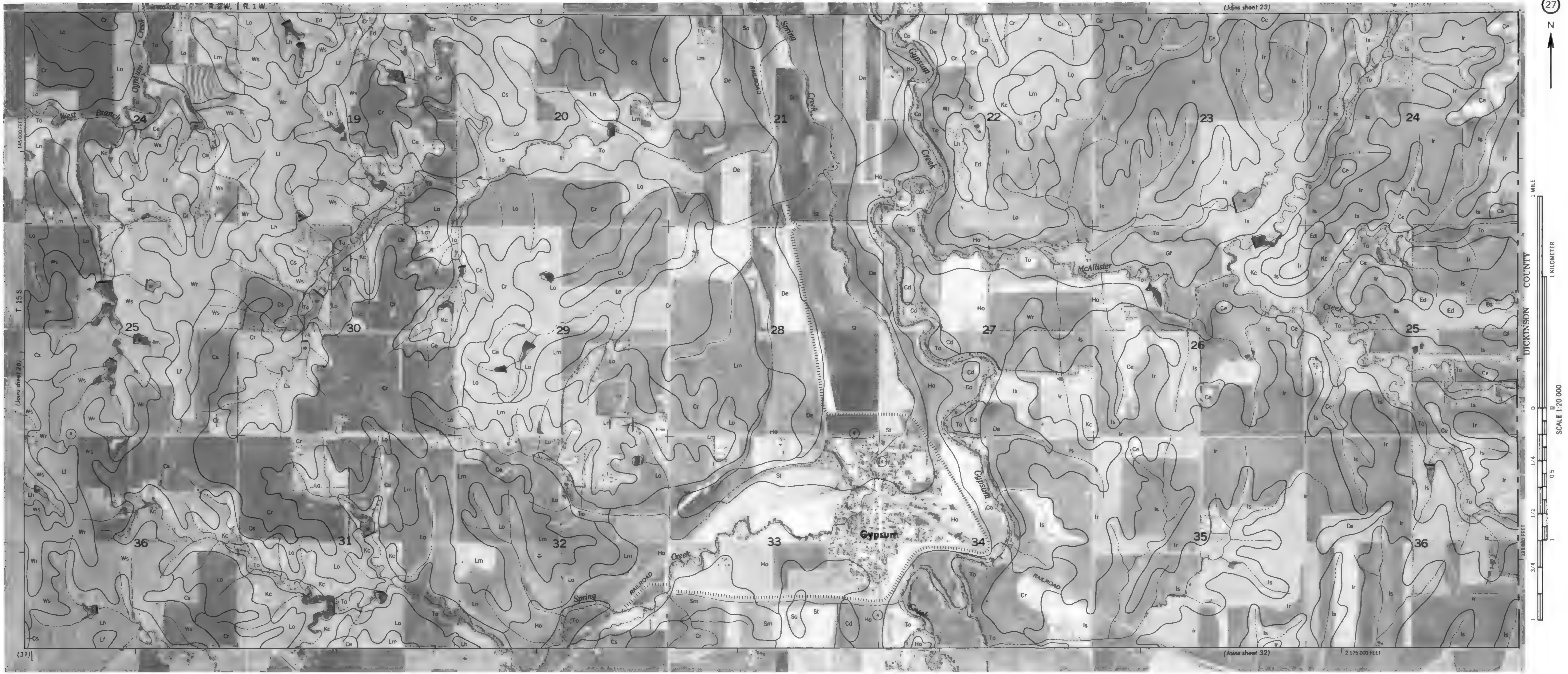
22
N
SALINA
(County seat)
1 MILE
1 KILOMETER
SCALE 1:20 000
(Joins sheet 21)
(Joins sheet 23)
(Joins sheet 26)
2 110 000 FEET
ABANDONED RAILROAD
RAILROAD
Dry Creek
West Dry Creek
East Dry Creek
SMOKY HILL RIVER
Dry Creek Diversion
water
Mentor
T. 15 S.


23
N
(Joins sheet 18)
(Joins sheet 22)
(Joins sheet 27)
2 175 000 FEET
T. 15 S.
Kipp
Gypsum
Creek
RAILROAD
West
Branch
Spring
Creek
Gypsum
DICKINSON COUNTY
1 MILE
1 KILOMETER
SCALE 1:20 000
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18


24
N
1 MILE
1 KILOMETER
SCALE 1:20 000
(Joins sheet 20)
R. 5 W.
R. 4 W.
T. 15 S.
(Joins sheet 25)
(Joins sheet 29)
(sh 28)
2 040 000 FEET
135 000 FEET
SMOKY HILL AIR NATIONAL GUARD RANGE
Soldier Cap Mound
Ralston Creek
Spring Creek
Castle Creek
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36


25
N
R. 4 W. | R. 3 W.
(Joins sheet 21)
(Joins sheet 24)
(Joins sheet 26)
(Joins sheet 30)
(sh 29)
T. 15 S.
SMOKY HILL AIR NATIONAL GUARD RANGE
Smolan
RAILROAD
ABANDONED
West Dry Creek
Middle Dry Creek
1 MILE
1 KILOMETER
SCALE 1:20 000

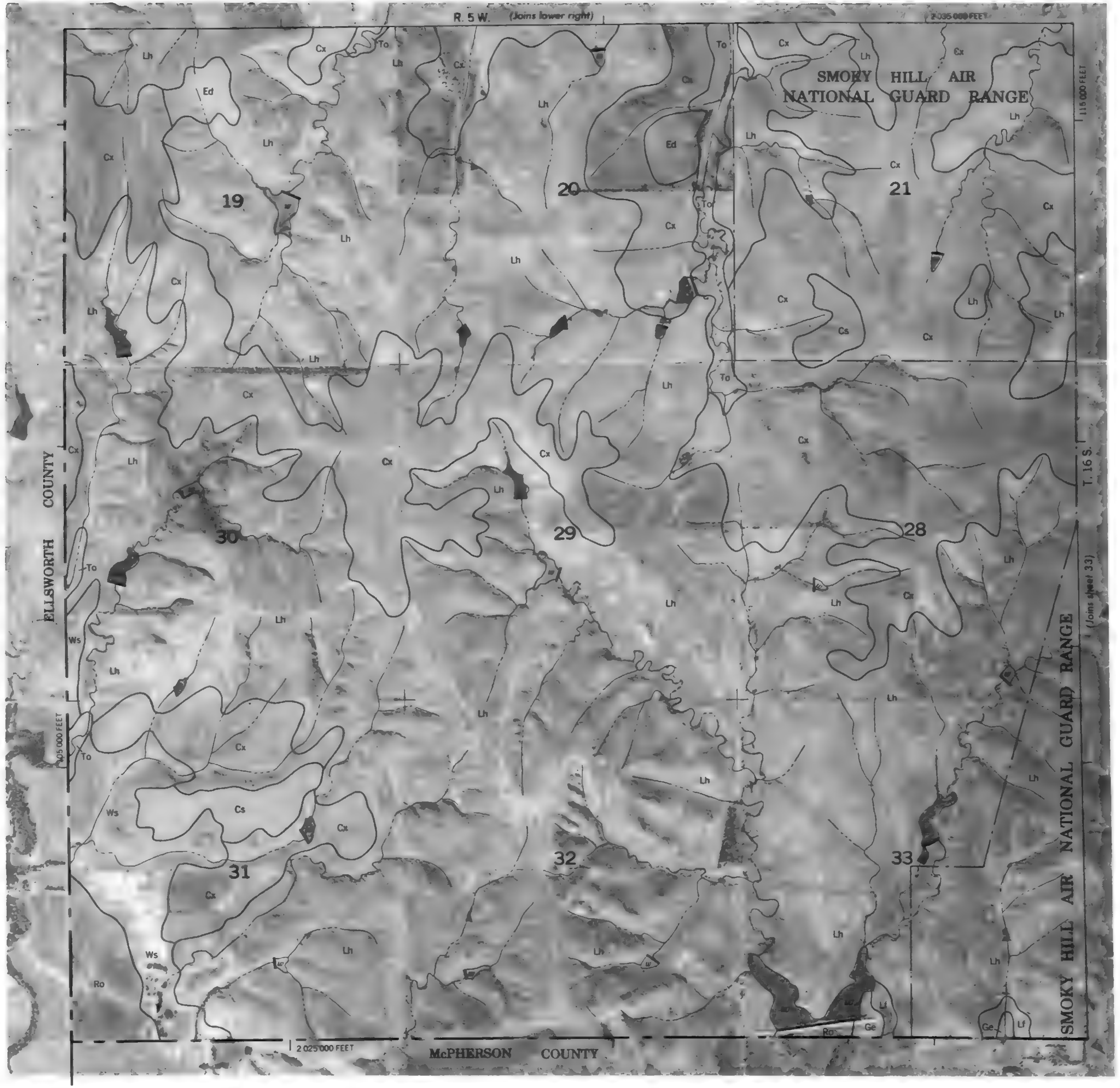

26
N
R. 3 W. | R. 2 W.
(Joins sheet 22)
(Joins sheet 31)
(Joins sheet 27)
(Joins sheet 25)
(30)
T. 15 S.
2 110 000 FEET
145 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0.5
Mentor
West Dry Cr.
Dry Creek
Dry Creek Diversion
Middle Dry Creek
RAILROAD
SMOKY HILL RIVER
Gypsum Creek
West Branch
Southeast of Saline School
135
81
104
4
23
24
19
20
21
22
23
26
25
30
29
28
27
26
35
36
31
32
33
34
35

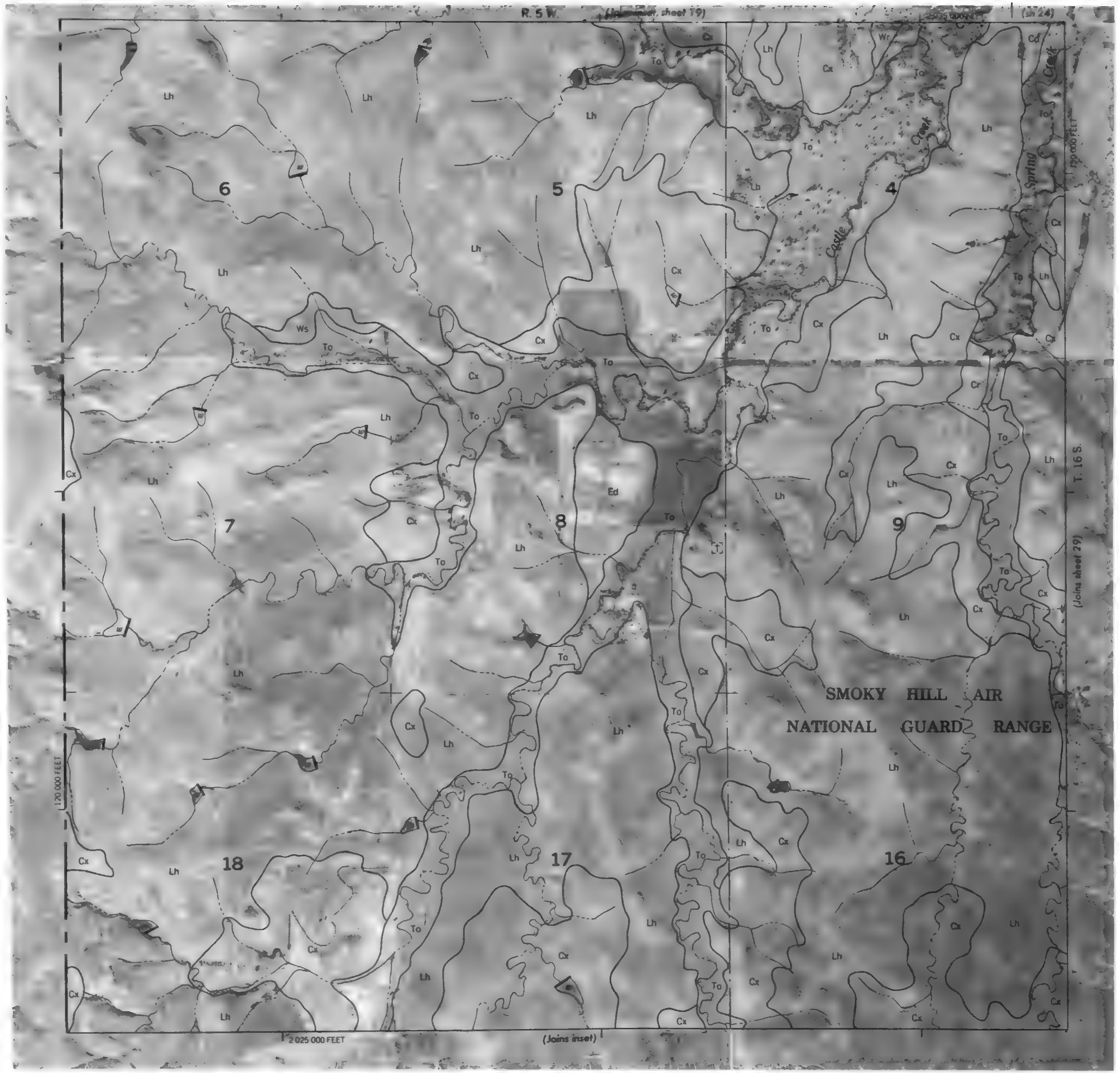

27
N
R. 2 W. | R. 1 W.
(Joins sheet 23)
(Joins sheet 26)
(Joins sheet 32)
(31)
T. 15 S.
145 000 FEET
135 000 FEET
2 175 000 FEET
West Branch Gypsum Creek
Spring Creek
Gypsum Creek
McAllister Creek
RAILROAD
Gypsum
DICKINSON COUNTY
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
1 MILE
1 KILOMETER
SCALE 1:20 000

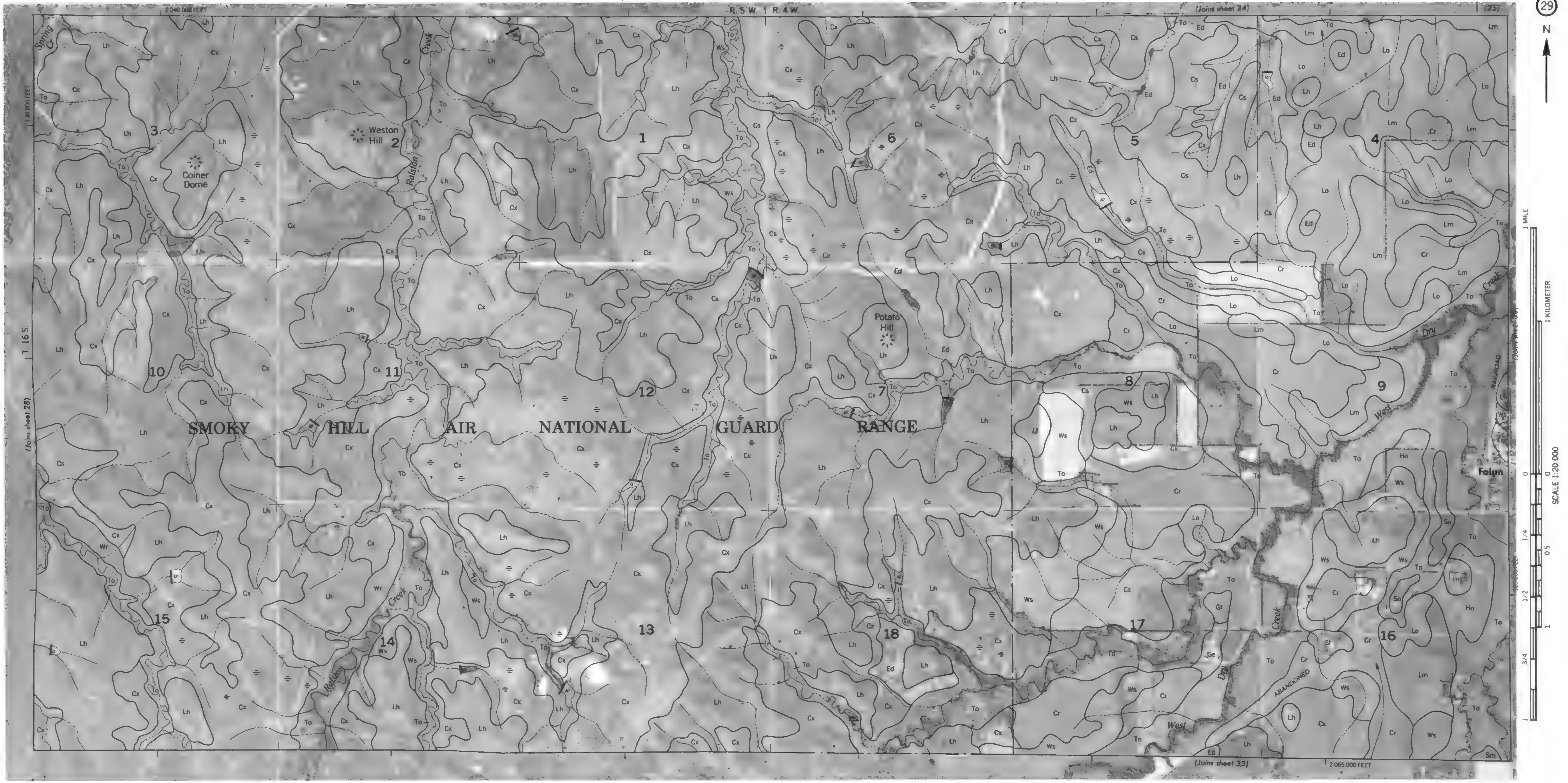
28

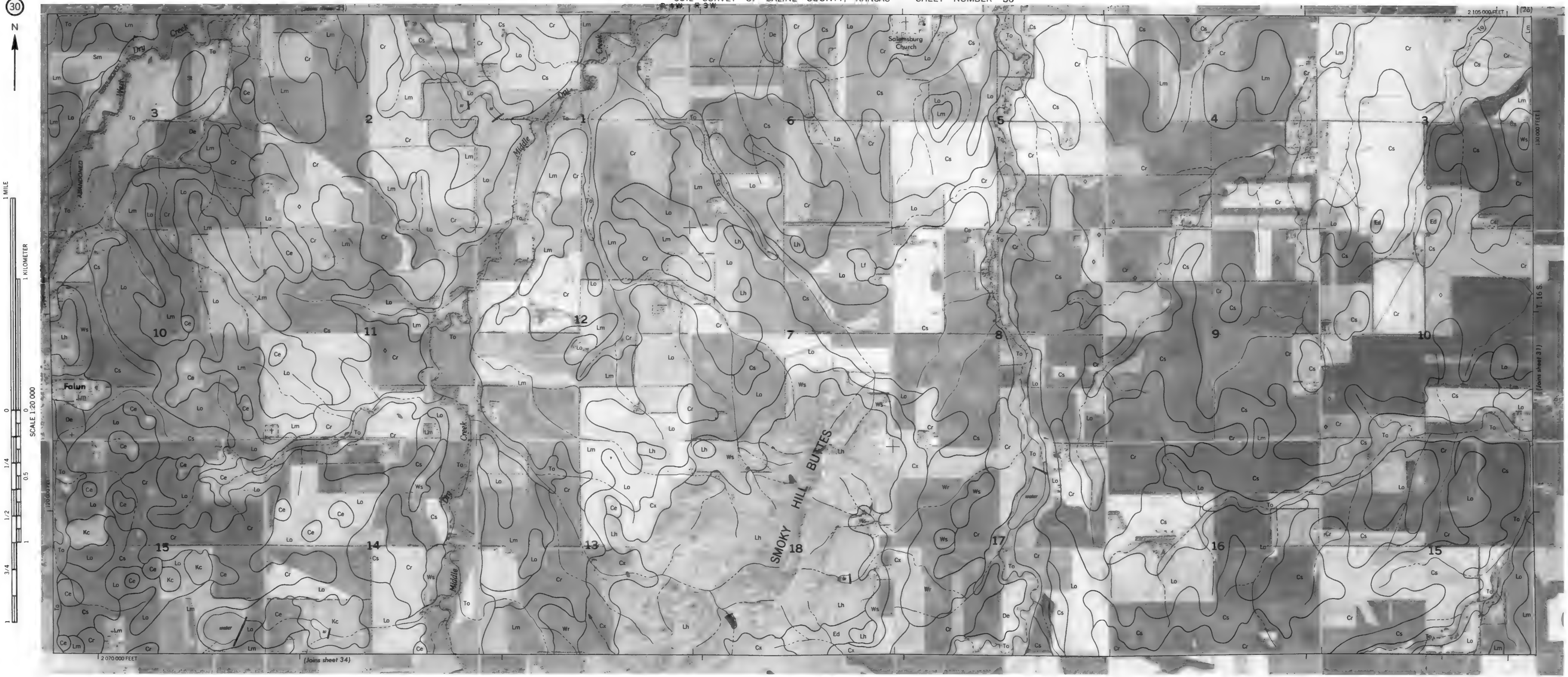
N

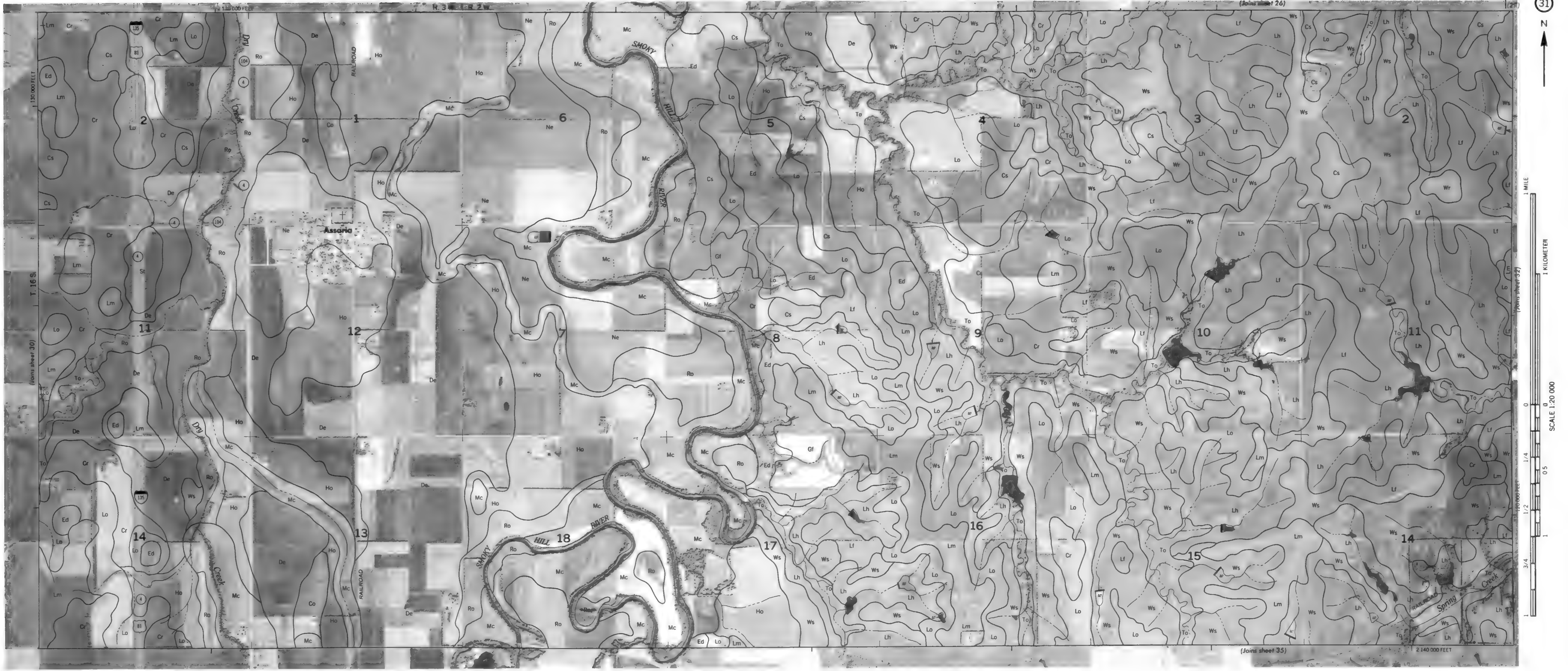
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1

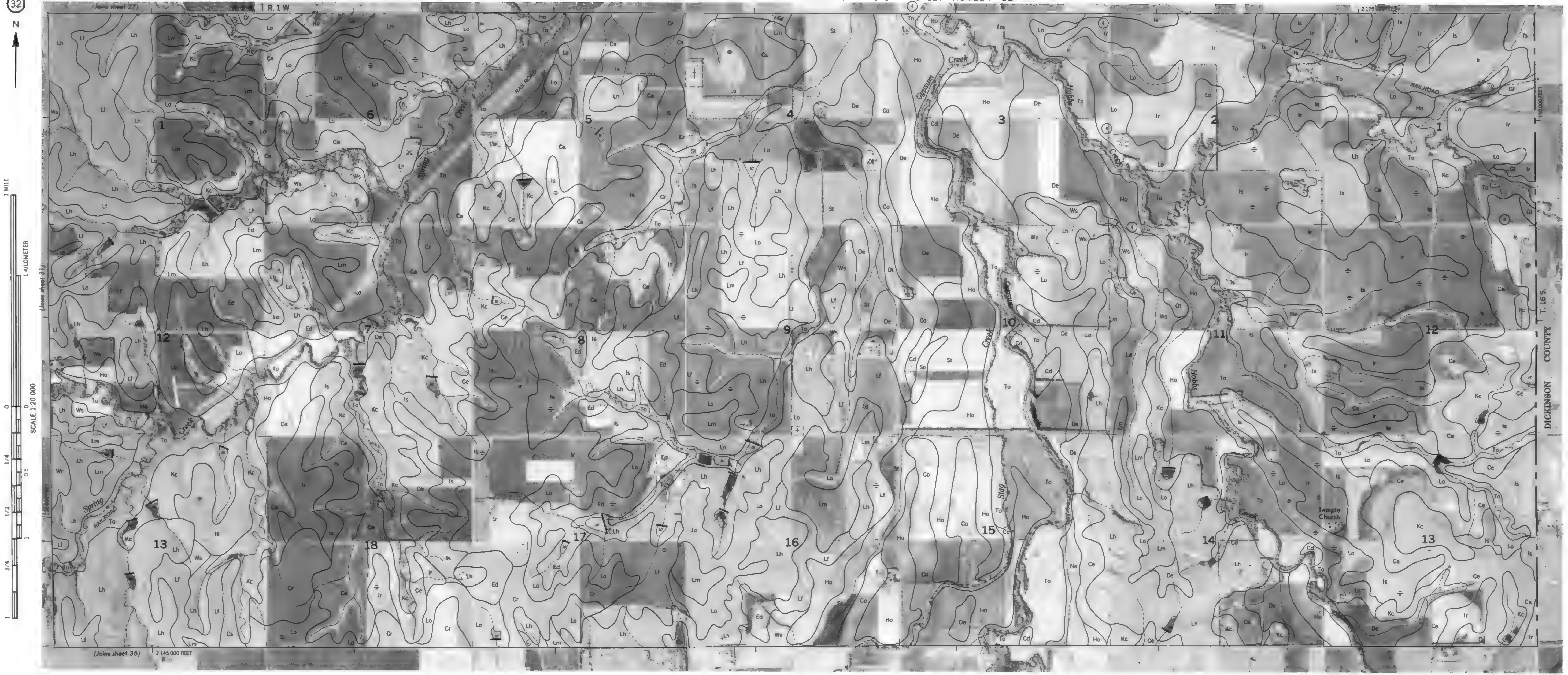


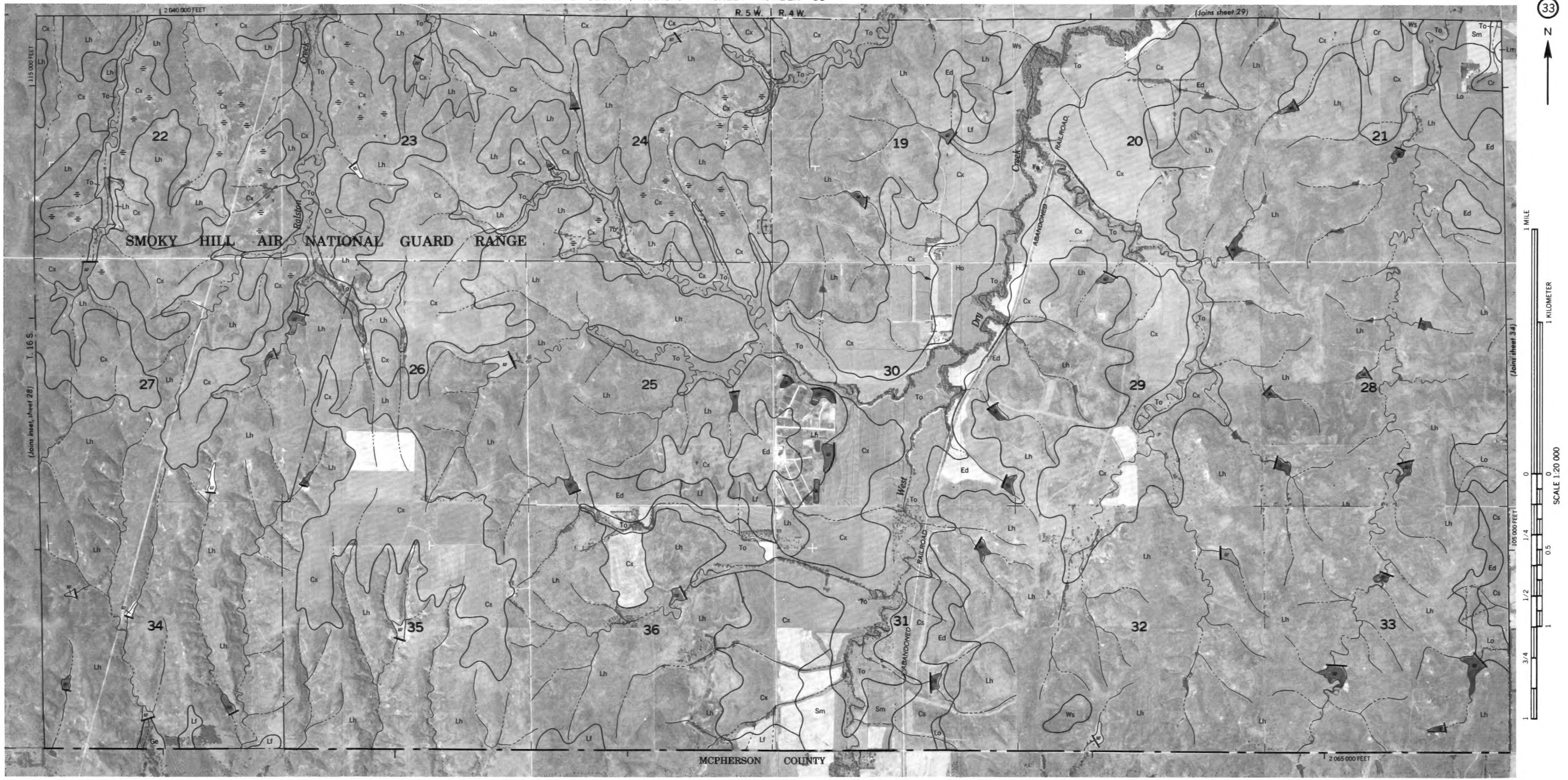


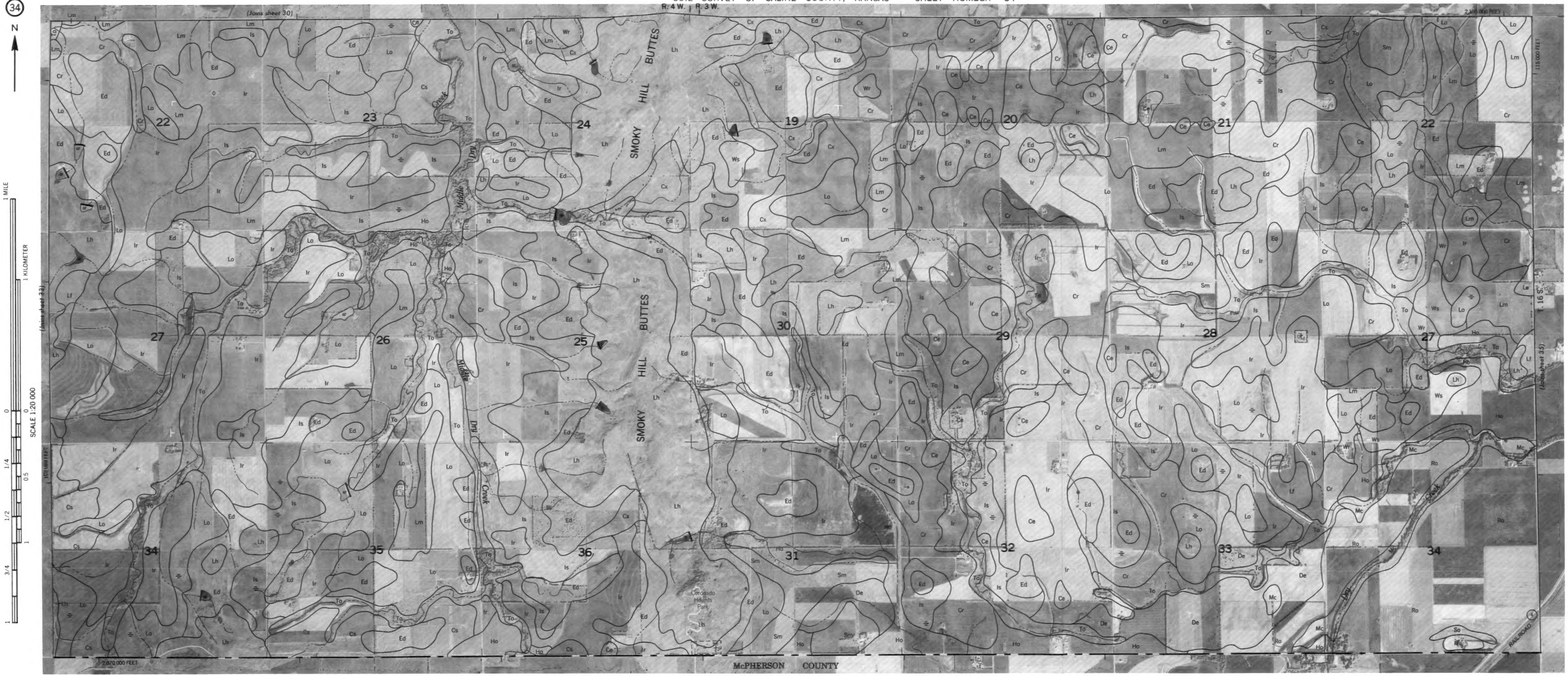

29
N
(Joins sheet 24)
R. 5 W. | R. 4 W.
2 040 000 FEET
T. 16 S.
(Joins sheet 28)
(Joins sheet 33)
2 065 000 FEET
Spring Cr.
Ralston Creek
Weston Hill
Coiner Dome
Potato Hill
SMOKY HILL AIR NATIONAL GUARD RANGE
West Dry Creek
RAILROAD
ABANDONED
Falun
1 MILE
1 KILOMETER
SCALE 1:20 000

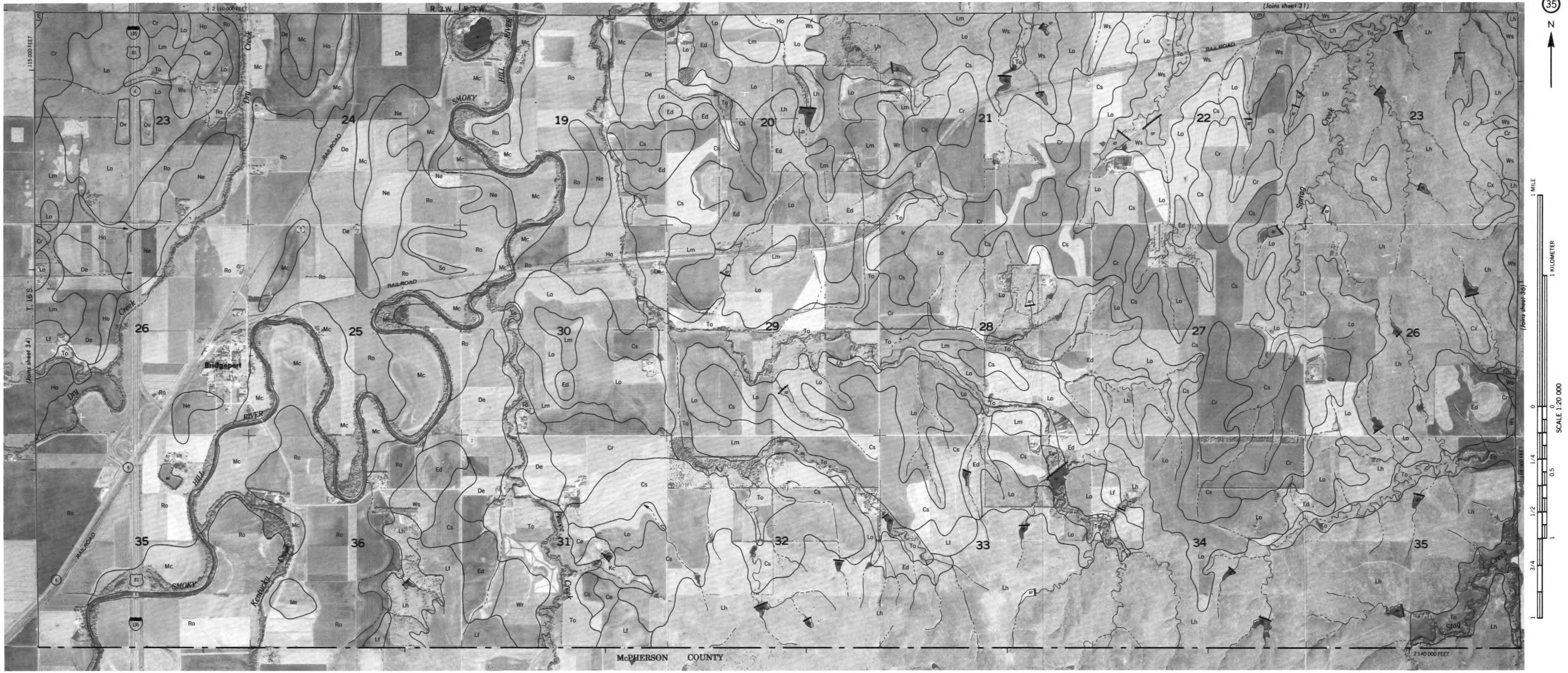

30
N
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0.5
R. 3 W.
2 105 000 FEET
(Joins sheet 34)
(Joins sheet 31)
2 070 000 FEET
130 000 FEET
T. 16 S.
Salemsburg Church
Falun
SMOKY HILL BUTTES
Dry Creek
Middle Dry Creek
West Dry Creek
ABANDONED
water


(Joins sheet 26)
(Joins sheet 30)
(Joins sheet 32)
(Joins sheet 35)
R. 3 W. | R. 2 W.
T. 16 S.
Assaria
SMOKY HILL RIVER
Dry Creek
Spring Creek
RAILROAD
2 140 000 FEET
1 MILE
1 KILOMETER
SCALE 1:20 000
N
31


N
1 MILE
1 KILOMETER
SCALE 1:20 000
(Joins sheet 27)
R. 1 W.
(Joins sheet 31)
(Joins sheet 36)
2 145 000 FEET
2 175 000 FEET
T. 16 S.
DICKINSON COUNTY
Spring Creek
Gypsum Creek
Hobbs Creek
Stag Creek
RAILROAD
Temple Church


33
N
(Joins sheet 29)
(Joins sheet 34)
(Joins inset, sheet 28)
R. 5 W. | R. 4 W.
T. 16 S.
2 040 000 FEET
2 065 000 FEET
115 000 FEET
105 000 FEET
SMOKY HILL AIR NATIONAL GUARD RANGE
MCPHERSON COUNTY
Ralston Creek
Dry Creek
West
ABANDONED RAILROAD
1 MILE
1 KILOMETER
SCALE 1:20 000
0
1/4
1/2
3/4
1
0.5


34
N
1 MILE
1 KILOMETER
SCALE 1:20 000
(Joins sheet 30)
R. 4 W. | R. 3 W.
(Joins sheet 33)
(Joins sheet 35)
T. 16 S.
SMOKY HILL BUTTES
SMOKY HILL BUTTES
SMOKY HILL BUTTES
Middle Dry Creek
Middle Dry Creek
Dry Creek
Coronado Heights Park
RAILROAD
2 070 000 FEET
McPHERSON COUNTY
22
23
24
19
20
21
22
27
26
25
30
29
28
27
34
35
36
31
32
33
34


35
N
(Joins sheet 31)
(Joins sheet 34)
(Joins sheet 36)
R 3 W. R 2 W.
T. 16 S.
2 110 000 FEET
115 000 FEET
2 140 000 FEET
SMOKY HILL RIVER
Bridgeport
RAILROAD
Dry Creek
Kentucky Creek
Spring Creek
Stag Creek
McPHERSON COUNTY
1 MILE
1 KILOMETER
SCALE 1:20 000


36
N
(Joins sheet 32)
R. 2 W. | R. 1 W.
(Joins sheet 35)
T. 16 S.
DICKINSON COUNTY
McPHERSON COUNTY
MARION COUNTY
Stag Creek
Gypsum Creek
Harvey Creek
Hobbs Creek
1 MILE
1 KILOMETER
SCALE 1:20 000
2 115 000 FEET
2 145 000 FEET
115 000 FEET
105 000 FEET